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SOME AMERICAN BRAKE TESTS.

THE Board of Railroad Commissioners, of New York State, decided last year to have some tests made upon various car brakes, and have issued a report upon the tests, from which, however, there appears to be required a considerable discount for inaccuracy, if, as stated by the *Street Railway Review*, there exist the discrepancies noted therein. The tests were intended to be good and reliable, and to this end the Board's electrical expert, Mr. Barnes, designed, in collaboration with Mr. W. A. Pierson, a recording apparatus to show how many feet a car would run after the stop signal was given. It also showed the time in seconds that was occupied in bringing the car to rest.

The apparatus consisted of a pair of 24-inch leather-covered wheels held down to the rails by springs, and on the same axle was a chain wheel imparting motion through gears, friction clutch and screws, to the recording platen. There was a powerful clock movement for the time record, and a Boyden speed indicator. We are further informed that the instrument was calibrated on a piece of track 275 feet long, and it was found that with a movement of the recorder of 51½ inches, which was its maximum, the car would travel 203½ feet, so that a stop in 200 feet could thus be registered. The time movement was arranged to give a time limit of 16⅔ seconds. The intention and provision thus appear to have been good.

The tests to be conducted on each car submitted were 14 in number:—Three at 8 miles per hour, three at 12 miles, three at 15 miles, three at 16 miles, and two at 16 miles with sand, all the other tests being dry rail tests without sand.

In conducting a test the speed indicator hand was set to the intended speed. When this speed was attained, a circuit was closed which caused a clutch to move. When this clutch was closed, it in turn closed another circuit, and rang a bell to signal the motorman to throw off current and apply the brake. Obviously, there is great opportunity for delay and inaccuracy in this arrangement. With the rapid acceleration of an electric car there is no doubt that errors could creep in. The car would accelerate after the electrical contact of the speed indicator and before this was communicated to the motorman. The personal lag of the man would also add to the time loss, and the criticism of the *Street Railway Review* seems to have had probabilities to support it, as to which more anon. The recording instrument was set in motion by the speed instrument closing the circuit as first named. It was kept in motion until the car stopped, and the curves given in the report, of which only our contemporary's abstract is before us, were thus automatically traced. Each competitor was at liberty to apply the brake himself if he preferred his own skill to that of the motorman. The various brakes were applied to one of the cars of the Metropolitan Street Railway, and the trials lasted over a period of three months, the cars being run on Lenox Avenue. Sixteen brakes were tested, comprising air, electric, hand power, friction track and wheel brakes, and a system of brake levers. No data are given of brake leverage or of the force available, nor any particulars of brake shoes, but where skidding took place it was observed and recorded as closely as possible by

D

observers. It is a pity so much trouble and expense should have been incurred upon tests that were so inaccurately recorded.

The report contains 66 diagrams, copies of the autographic records, and these embody 229 tests made supposedly at 8, 12, 15 and 16 miles per hour. Our contemporary quoted above states that whereas a speed of eight miles per hour is equivalent to 11·73 feet per second, the 54 curves for this speed do not in any one instance show that a car travelled so little as 11·73 feet in the first second after the stop signal was given. The maximum distance recorded was 23 feet; the minimum was 12 feet, corresponding respectively to 15·7 and 8·2 miles per hour. The same examination of the stops at 12 miles velocity appears to show that the speed varied from 24·9 to 5·5 miles per hour. The 15 miles curves indicate from 8·2 to 25·9 miles, while the 16 miles velocity curves show a minimum of 4·6 miles and a maximum of 51·2 miles. In some instances the cars travelled further in each of the second, third, fourth and even fifth seconds than they would travel at the intended initial speed in one second. In 13 cases the car actually ran further with the brakes on than it could have gone in the time at the nominal initial speed, and in seven of these cases the car was running up hill, so that no gradient effect can be advanced in extenuation.

As our contemporary points out, it is most unlikely that speeds of 30 to 50 miles per hour could be run by the car and mistaken by the observers for a speed of 16 miles only. Under these circumstances it is out of reason to accept the correctness of the apparatus, though full satisfaction is expressed with its exactness and efficiency throughout the entire tests.

For these reasons it does not appear to be even necessary to reproduce the figures and conclusions arrived at. The report professes to give to some 16 brakes a comparative standing. It may be that the time-recording apparatus was simply wrongly calibrated, and that every brake was similarly affected, but the figures already given point to a general unreliableness of the whole of the tests and apparatus, all responsibility for which apparently rests with Mr. Barnes. His report is considered to be what Dooley would call "very imposing—to anyone who could be imposed upon," though certain technical publications speak of it as valuable, and so on. Only two of the many autographic records are printed by the *Review*. They bear on their face a certain appearance of correctness if their time scale be altered—that is to say, the curves drawn are of the form that would be expected. It cannot be satisfactory to any of the companies represented to have gone to so much expense and trouble for such inconclusive results. Much might have been learned from these tests. As it is they are worse than useless, unless by an examination of the apparatus it could be found where the fault lay, and that it was one of proportionate amount throughout; this, however, is not borne out by the extreme range of speeds shown for each nominal speed. There were probably serious errors of observation, in addition to erroneous instruments, and we may well marvel that the report has been published with its own refutation autographically recorded on the diagrams.

On the general question of brake tests it appears to us to be better practice to let the vehicle attain something above the test speed, and to apply the brakes when the speed drops to the proper point. The brakeman ought to have the speed recorder under observation, the recording apparatus should be put into action by the first movement of the brake, and the actual brake application should be recorded by a dot on the already commenced curve, so that the first part of the curve would show unbraked retardation, due to rail and air resistance, and the brake effect would be shown by the second part of the curve. As an instance of the value of the report and tests, we may take from Table 10 a test at 8 miles per hour. The car was stopped in 6·6 seconds, during which it ran 72 feet. Its average speed during the time of stop was thus 10·91 feet per second. But its initial speed was given as 11·73 feet per second, and its final speed was, of course, zero. How is it possible that 10·91 can be any sort of mean between 11·73 and 0?

Again, at 16 miles per hour a car ran 211 feet in 7·9 seconds, or at an average velocity of 26·7 feet per second. But its initial velocity was only 23·46 feet per second, and we are asked to believe that the braked car ran 211 feet and came to rest at zero velocity, and yet had a mean velocity about 10 per cent. greater than its maximum or initial speed. A third test picked at random from the same table, and like the two just given not worked out by us, is one nominally of 16 miles initial velocity, or 23·46 feet per second. Here the stop was made in the same time of 7·9 seconds in the space of 148 feet, or at a mean speed of 18·7 feet. Clearly the tests are valueless. It is a marvel how such discordant figures can have been passed by the "expert" and launched into publicity, when a little elementary arithmetic serves to show their absolute inaccuracy.

It is the more curious in that so much labour was spent upon the description of the recording apparatus. Our American contemporary states that the Board of Commissioners are not versed in technical matters, and have to rely on their expert engineer.

Car Brake Details.

Now that the paltriness of detail that characterises American car practice is being severely criticised, and the servile copying of the same by the English builders is being resented, we may point out some deficiencies of construction to which the eye of the tramway official may particularly and earnestly be directed. Let us this week set the hand-brake in the pillory. So far as the brake shoes and gears are concerned, we do not propose to say much. Both pairs of wheels are pressed by their respective blocks with fairly equal pressure by means of a peculiar lever pinned to both of a pair of stiff brake beams, the lever acting on which, is pulled by a rod connected with a motorman's handle. Apart from an unfortunate low quality of iron used in these brake pull rods the gear may be left without further notice. But let the handle and its immediate connections be studied. We find a handle of considerable strength of gun-metal. It is fitted upon a vertical spindle that rises from below the car, passes through the buffer beam and through the iron floor sheet and up by the dash-board or plates to a short distance above the top of the plate. Near the floor of the car is a ratchet wheel in which works a pawl. This pawl is pushed in or out by the toe of the motorman's boot. The spindle passes loosely through a hole in the buffer beam, and has a bearing in a thin plate on the top of this beam. It projects 6 or 7 inches below the beam without support, and is, in fact, unsupported anywhere below the top side of the buffer beam. Just below the beam a piece of chain is fixed to the spindle. This chain forms the connection between the brake handle spindle and the pull rod. The brake is applied to the car by the winding of the chain upon the weak projecting spindle. The whole device is most crude, insufficient, and unsafe, and totally unfit to be relied upon to hold a heavy car on gradients of 1 in 10, or even sharper grades on which it is regularly employed. The weak projecting unsupported end of the spindle is an offence to mechanical construction and an invitation to disaster. Even such bearing as it might have is denied it, for there is no reason why there should not be a good bearing plate fastened on the underside of the buffer beam, so as to reduce the bending moment of the chain pull to a minimum. We presume this paltry device is handed down from horse-car days as another proof that the present electrical car is simply a magnified mule vehicle, and not designed by an engineer for power traction, nor made of any such quality of material as to indicate that car builders have a due appreciation of the necessities and requirements of electric traction. Design in cars has been purely perfunctory, and not conducted along rational lines. As the first railroad cars were but coaches put on to iron wheels and axles, so the electric tramcar has simply developed somewhat from the light horse car, and many of its details are far from sufficient for their purpose. But there is no detail so miserably insufficient as the brake spindle, with its chain pull and its toe-operated ratchet gear.

ELECTRICAL TRAVELLING CRANES.

By CLAUDE W. HILL.

The successive steps in the development of the electric traveller are shown in the following diagrams :—

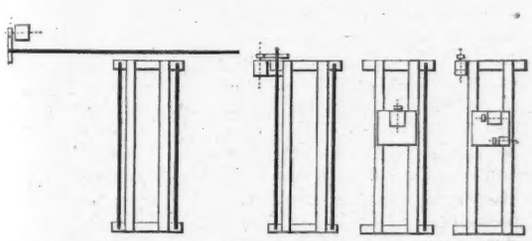
Fig. 1 shows the first step in the utilisation of electricity in which the square shaft (or rope) running along the gantry is driven by an electric motor, and the arrangement is called "an electric crane."

In fig. 2 the longitudinal square shaft or rope is done away with. A motor is mounted on the end carriage of the crane, the longitudinal travel is taken direct from the motor, and two square cross-shafts are used to transmit the motion to the crab for hoisting and traversing.

In fig. 3 the motor is placed on the crab. In this case the hoisting and cross-traverse motions are taken direct from the motor, and one cross-shaft only is required to transmit the motion for the longitudinal travel.

In the preceding examples a shunt-wound motor, running continuously, is used, and the different motions are started and stopped either by clutches or by belts running on fast and loose pulleys. The only electrical controller required is an ordinary starting switch for the motor.

In fig. 4 cross-shafts, belts and clutches, are all done away with, and a separate motor is fitted for each motion. The motors are series wound, each has its own controller, and the hoisting train consists of plain spur wheels with an automatic electric brake to retain the load when the hoisting motor is stopped, so doing away with the necessity for worm gear.



Figs. 1 to 4.—Successive Steps in Construction.

Single-Motor Cranes.—The single-motor crane, of which examples are given in the first three figures, is somewhat looked down on at present. This is to some extent due to the fact that it has not received the same attention from designers as has been the case with cranes of the multiple-motor type. In the design of the latter every care has been taken to make the most of the advantages conferred by the use of electricity, while for the single-motor type any ordinary mechanical crane has been considered good enough with a shunt motor tacked on.

As the motor in this kind of crane runs continuously, it should be designed to take the least possible current when running idle, and to do this compound winding should be used with a special form of toothed armature.

By placing the clutches for the different motions on an extension of the armature shaft this would be the only moving part when the crane was idle, and as the torque transmitted by the clutches would be small their design could be simple. By using an automatic electric brake on the hoisting train this could also be simplified.

A crane so made would not offer all the advantages of a multiple-motor crane, but it would be superior to any mechanical form, and would commend itself to purchasers who did not feel justified in going to the expense of the multiple-motor type.

Multiple-Motor Cranes.—As shown in fig. 4, a motor is placed to each motion. Generally three motors are used, but occasionally a supplementary motor is placed on the crab to deal with light loads at quick speeds, and sometimes two motors are used for the longitudinal travel with a series parallel controller so as to obtain two speeds.

The motors being series wound their torque increases in a more rapid ratio than their current, so that they will take a given overload with a less expenditure of current than shunt machines, they also to a certain extent adapt their speed to the load running fast with a light load and slow with a heavy one, and as their gap excitation increases with the current, sparking is prevented and the commutators preserved. Each motor being separately controlled, a wide variation of speed is possible, while when not required the motor is stopped altogether, so that there is no expenditure of current except when work is being done. An example of the variation of speed of a series motor with variation of load on the crane hook is given in fig. 5.

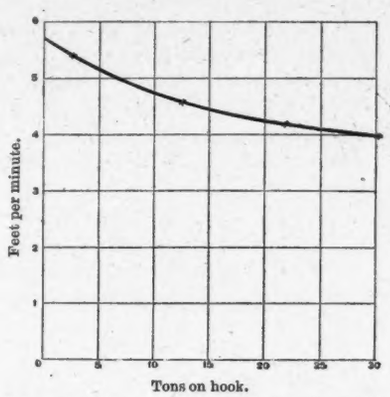


Fig. 5.—Speed and Load Curve with Series Motor.

Controllers.—To a large extent controllers having liquid resistances have been used. These are fairly satisfactory, but they have their disadvantages. It is difficult to adjust the strength of solution to the resistance required, and evaporation soon destroys the adjustment. If the resistance is too low the motor starts off with a jump as soon as the blades touch the liquid, and if it is too high there is a jump when the metallic contacts come together, and a bad arc when they part. Further, the fumes from the liquid are liable to cause sickness, which is inconvenient to the men working below.

For the traversing motions metallic controllers of the tramway type are satisfactory, but for the hoisting motion a controller giving more gradual changes of speed is necessary, and it should in addition carry extra contacts for the simultaneous operation of the electric brake.

Where the distance through which the load is to be lowered is short, there is not sufficient time for it to acquire a speed high enough to result in injury to the motors or gearing if it is allowed to run down freely.

Where, however, the distance is considerable, means must be provided to prevent the load attaining a dangerous velocity, and a convenient way of doing this is to have an additional position on the controller in which the armature of the motor is short circuited through a resistance so connected that the motor runs as a dynamo driven by the descending load. This arrangement works well; it is frequently invented, and is repatented from time to time.

An example of a multiple-motor crane recently designed by the writer is illustrated herewith, the illustrations being taken from the working drawings.

The particulars of this crane are as follows :—

Load 30 tons. Lifting speed 4 feet per minute. Speed of cross traverse 100 feet per minute. Span 97 feet from centre to centre of gantry rails. Length of gantry about 1,000 feet. Speed of travel 400 feet and 200 feet per minute.

Fig. 6 is a side view of the crab, the underframe of which is made of steel **H** joists, upon which are mounted cast-iron fixings to carry the various shafts. For the lift a motor of 20 B.H.P. is provided. Change of speed for light loads is obtained either by altering the gear, for which purpose a clutch is provided, or by switching the motor magnets into two parallels.

A section of the automatic brake is given in fig. 7. This brake is the writer's patent, and was described in the Electrical Review of March 16th last.

The load is taken on eight flexible steel wire ropes ⅞-inch diameter. The drum is grooved and two ropes wind on at a time, so keeping the load vertical. The rope is, of course, this case a lever arrangement has been adopted to equalise the load on the three wheels, and is shown in fig. 8. Two motors of 20 B.H.P. are provided for the travelling motion

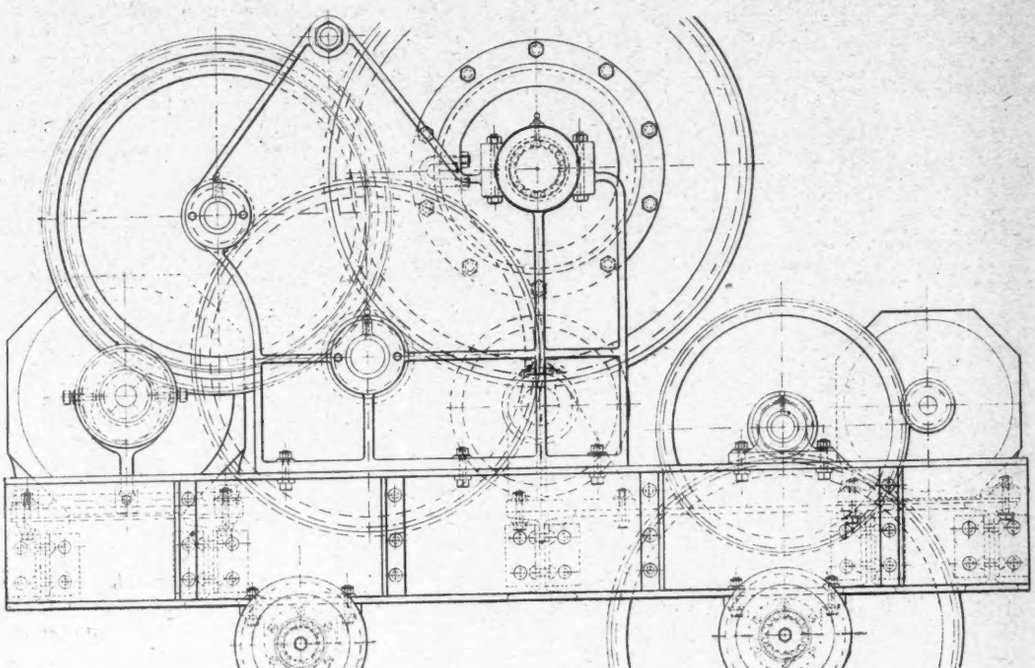


Fig. 6.—Side View of Crab.

continuous with an equalising pulley at its centre. For the cross traverse a motor of 15 B.H.P. is provided, and the axles of the crab wheels have roller bearings. Owing to the considerable weight of the crane when fully loaded the end

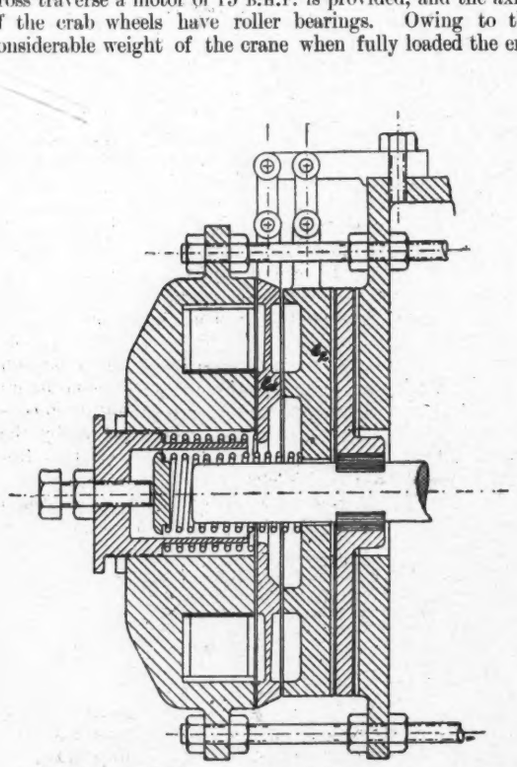


Fig. 7.—Section of Brake.

carriages are provided with three wheels. With the three wheels it is necessary that a spring should be provided for the middle wheel, or that an equalising lever should be fitted. In

with a series parallel controller, so that the two speeds of 400 feet and 200 feet per minute can be obtained without

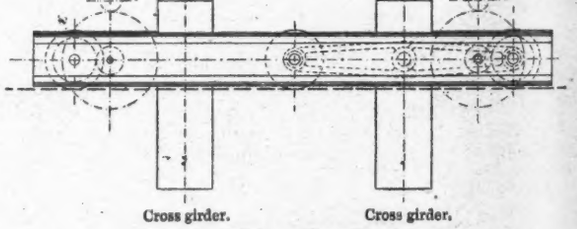


Fig. 8.—View of End Carriage.

inserting resistance. To prevent over running these motors have automatic brakes of the same general design as shown in fig. 7, but of somewhat simpler construction.

STANDARD DIRECT-CONNECTED UNITS.

At the Cincinnati meeting of the American Society of Mechanical Engineers a preliminary report was made by the committee on the standardising of engines and dynamos as affecting those parts which are connected, which are abstracted as below in the *Street Railway Review*.

The three points taken up first were: The sizes or capacities of machines which should be standardised; the speeds at which these various sizes of machines should be operated; the diameter of armature bore for each different size of machine. The recommendations received from engine builders were reported as being remarkably uniform as regards these three points.

The committee was unanimously of opinion that in order to secure practical results it should strive not for theoretical perfection, but for a result which, while recommending

thoroughly good practice, would at the same time coincide as far as possible with the practice of the greatest number of manufacturers. Also, that it was not desirable to have too many standard sizes, involving, as such a course would, the storage of a large number of patterns and carrying large amounts of stock for both engine and dynamo builders.

The sizes recommended as standard are 25, 35, 50, 75, 100, 150, 200 and 250 KW.

STANDARDS PROPOSED FOR DIRECT-CURRENT DIRECT-CONNECTED ENGINES AND DYNAMOS.

Capacity in KW.	Speeds in revolutions per minute.	Armature bore in inches.	
		For centre-crank engine.	For side-crank engine.
25	300 to 325	4	4½
35	285 to 315	4	5½
50	270 to 300	4½	6½
75	250 to 280	5½	7½
100	250 to 275	6	8½
150	200 to 225	7	10
200	175 to 200	8	11
250	150 to 175	9	12

With respect to the matter of speeds for these standard sizes, the principle already stated, of choosing those which so far as possible conform to the practice of existing manufacturers, was followed. As two of the members of the committee represent two of the largest manufacturers of electrical machinery in the country, it had the benefit of a knowledge of what would suit the builders of generators as well as the builders of engines, and the speeds recommended apply to a very large majority of the engines and generators which have thus far been turned out.

It will be observed in the table of speeds given that the committee has recommended an upper and lower limit for each size of generator and engine. The reason for this is that while the generator builders had already constructed machines for these extreme ranges, some of the engine builders tended rather to the lower and others rather to the upper limit. While in a very few cases some engine builders go slightly outside the limits, yet the limits recommended cover nearly all the data which were collected.

With respect to the subject of armature bores there are two classes of engines, designated commonly as "side crank" and "centre crank." In the very small sizes it will probably be found possible to use only a single size of bore, but for the standard sizes recommended engine builders practically insist upon two separate series of dimensions of shaft.

One of the members of the committee made a special investigation of this subject, and secured the opinions of a large number of engine builders with respect to the sizes which would suit them, which enabled the committee to reach a conclusion quite readily.

The tentative recommendations of the committee are given in the table. A number of other matters on which it seems practicable to make an agreement will be taken up later.

HIGH POWER SINGLE-CYLINDER ENGINES AT THE PARIS EXHIBITION.

E. KILBURN SCOTT.

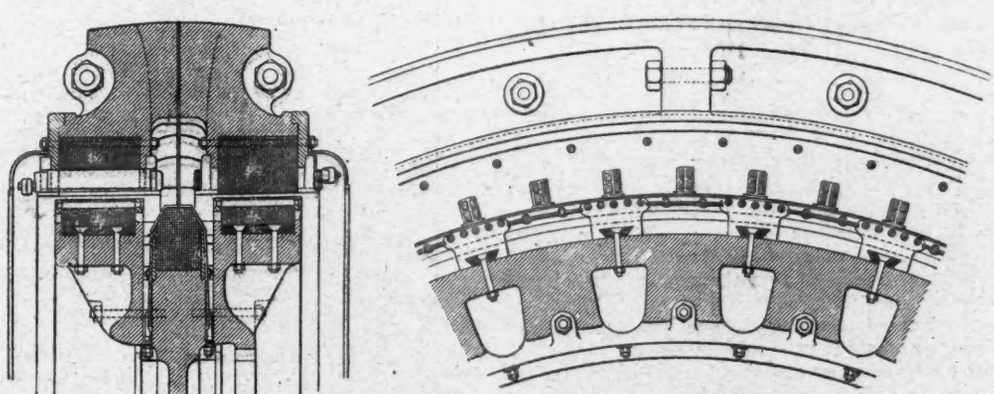
In the French Section of the Electricity Building there are to be seen several examples of large horizontal *single*-cylinder engines. In these days of high-speed engines, which have as an object the obtaining of a large number of impulses per minute, it is somewhat startling to find several well-known Continental firms going right back to first principles, and building single crank slow speed engines of upwards of 1,000 H.P. It is the more remarkable, because in most cases they have been built for the special purpose of driving *alternators*, the very machines of all others which for paralleling, &c., are supposed to require a multiplication of cranks.

Altogether there are five examples of large single-cylinder engines in the French Section. They are :—

—	H.P.	Speed.	Valves.	Remarks.
Garnier & Faure Beaulieu	400	90	Corliss	An air pump at end of cylinder.
Piquet & Co. ...	600	94	Flat slide	Coupled to Grammont alternator.
Weyher & Richemond	1,000	...	...	Valves operated by bevel gears and rods. Stroke only 39⅜ inches.
Ditto	500			
Joseph Farcot...	1,300	78½	Corliss	Coupled to Farcot alternator, with Hutin & Leblanc "Amortisseur" coils.

Besides these, however, there are in the various Continental Sections many large engines with single cranks. Thus Messrs. Carels Bros., of Ghent, show a tandem compound horizontal engine of 1,000 H.P. The cylinders are 26 inches and 41⅓ inches by 45¼ inches stroke, and the engine drives a 560 KW. three-phase 3,000-volt Kolben alternator. Messrs. Sulzer Bros. also exhibit a tandem compound engine with single crank, which is used for driving a three-phase alternator by Messrs. Rieter & Co., the fly-wheel of which is exceedingly heavy.

Of the single-cylinder engine set, the largest—that by Farcot—is perhaps the most interesting. The cylinder is 39⅓ inches diameter by 53 inches stroke, and when supplied with steam at 100 lbs. per square inch will indicate 1,300 H.P. with one-fifth cut off and 78½ revolutions per minute. It is



DETAILS OF CONSTRUCTION OF 750-KW. TWO-PHASE ALTERNATOR.

stated that the following steam consumptions per brake horse-power-hour have been obtained :—

1/10 cut off	700 B.H.P.	... ...	13½ lbs. steam.
⅕ „	1,020 „	... ...	14½ „ „
3/10 „	1,230 „	... ...	16½ „ „

the condenser showing 28 inches of mercury.

The cylinder consists of a liner inserted in the steam jacket, the cylinder ends being also steam jacketed, and carrying the Corliss valves, so as to reduce clearance as much

as possible. The governor is fitted with means for varying the speed of the engine whilst running, for synchronising purposes. All the power having to be transmitted through one crank, the size of the shaft is very large, the diameter at the fly-wheel being 25⅝ inches, and the bearings 17¾ and 15¾ inches.

The alternator is also built by Farcot, and gives 750 KW. two-phase at 2,200 volts and 42 cycles per second. It is of the inductor type, the field magnet being divided into two rings, each consisting of 32 poles. These poles are laminated, and held to the fly-wheel by dove-tailed iron pieces, as shown in the figure herewith. The field coil consists of 460 turns of 7·5 mm. diameter copper wire, having a resistance of 3½ ohms. It rotates with the fly-wheel, so that the machine is not a true inductor machine. The exciting current is 50 amperes, and with a power factor of ·85, the drop in voltage is about 10 per cent. The diameter over the poles is 5·5 metres (18 feet), giving a peripheral speed of 4,440 feet per minute.

The armature is divided into two rings, each having its own winding, the coils being staggered so as to give the two phases. The coils are wound in slots, and consist of copper strip 3½ mm. × 38 mm., or 133 square mm. in area, the resistance of each half, when warm, being 0·113 ohm. The weight of the armature complete is 60 tons.

A feature of the machine is, that each crown of poles carries a Hutin and Leblanc "amortisseur." As will be seen from the figure, this consists of a copper squirrel cage, the section of the conductors being 28 mm. in diameter. It is claimed for the "amortisseur" that it tends to prevent hunting, and, together with the weight of the revolving parts, enables the machine to work very well in parallel, although driven by a slow-running *single*-cylinder engine.

The adoption of a single cylinder for such large powers seems strange, and yet there are the undoubted advantages of extreme simplicity, cheap construction, and ease of repair. All the single-crank engines exhibited, appear to work most satisfactorily, and without any sign of vibration.

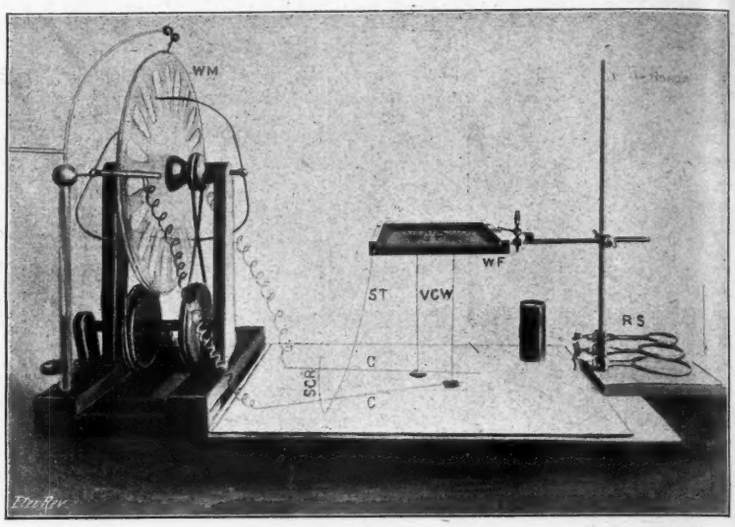


Fig. 1.—Apparatus for making Robertson's Figures of Electrostatic Force.

DUST FIGURES OF ELECTROSTATIC LINES OF FORCE.

By DAVID ROBERTSON, B.Sc., A.G.T.C., A.I.E.E.

The method of getting pictures of magnetic lines of force by means of iron filings is so well known that it is surprising that the making of analogous pictures of electrostatic lines does not also form one of the regular lecture-table experiments of every elementary class on electricity. More especially is this the case now that electrostatic phenomena, which at one time were considered of purely scientific interest, are every day becoming of more importance in the application of electricity to practical purposes.

Some time ago the writer described * a method of obtaining such pictures with the apparatus illustrated in fig. 1. Tinfoil electrodes of any desired form and number are stuck on one side of a sheet of glass, and this is laid in the wooden frame, W F, with the tinfoil on the under side. A half-plate photographic glass is a convenient size to use, and then a plate carrier from a camera or an ordinary printing frame will serve to hold it, but larger plates may be used with advantage. Vertical connecting wires, with spring tops, make contact with the tinfoil electrodes, and put them into connection with the poles of an electrical machine through the bare connectors, C, and fine spirals of covered wire. These connectors are insulated from the table by a sheet of glass or ebonite. Each electrode will have a separate vertical wire, and the connections for any desired combination are easily made at the bottom by short pieces of bare wire. Another bare rod, S C W, lies across the two horizontal wires, so as to short-circuit the machine.

By means of a sieve or pepper pot fine sawdust is sprinkled as uniformly as possible over the top of the glass, and then the machine may be set in motion by an assistant. The operator should now start tapping the rod carrying the frame, &c., and then lift the short-circuiting wire by the silk thread, S T. Whenever the machine excites, the dust will be seen to gather into lines, and the action should be stopped by dropping the short circuiting rod as soon as the desired effect is obtained. The whole secret of getting good results lies in stopping it at the right moment. The tapping must, of course, be discontinued before S C R is dropped, or the dust will get shaken out of position again.

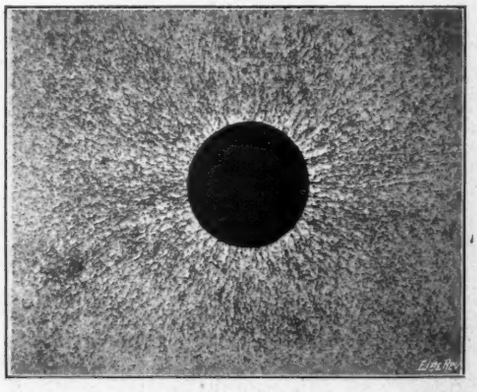


Fig. 2.—Field of a Single Disc.

By observing the following rules good results may be obtained with a little practice. The glass plate must be level, as otherwise the vibration produced by tapping, which is necessary to diminish friction, causes the dust to shift downwards. It should not be clamped in any way, but ought to lie loosely in the wooden frame, so as not to give vibration figures superimposed on the electric ones. The sawdust should be fine, but not powdery. That obtained from mahogany with a tenon saw or a coarse rasp does very well, and it is a good plan to blacken it with ink so as to make it more visible. Many other materials, such as tea leaves and oatmeal, will also do. When glass is used for

* See *Proc. Roy. Soc.*, Edin., 1898-99, page 361.

up later.

carrying the Corliss valves, so as to reduce clearance as much

insulating from the table, white paper should be placed below it. The dust is then easily seen against the white ground, which should be well lighted. This is the best way of looking at these curves. The glass plate should be carefully discharged in a current of hot air between each experiment.

The behaviour of the dust depends very much on the material of which it is made, on its fineness, and on the state of the atmosphere. With coarse sawdust the lines often draw together, and become more strongly marked when the action is prolonged, the ends at the same time gradually receding from the foil. At other times, more especially with fine light dust, almost as soon as the lines are formed it flies off the plate, beginning at the parts immediately over the tinfoil. It is this which necessitates the rapid discharge given by the short-circuiting rod. Most of the illustrations show the effect of the commencement of this jumping off in reducing the amount of stuff in the neighbourhood of the electrodes.

Several curves obtained in this way are reproduced in figs. 2 to 7. For fig. 2 only one electrode in the form of a

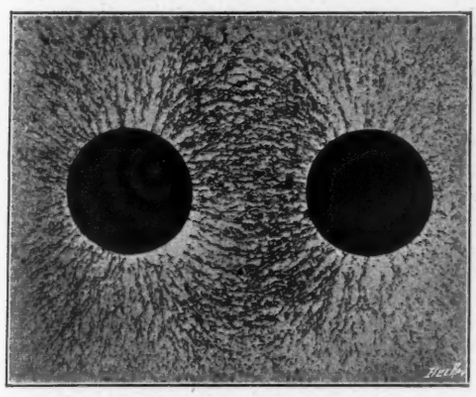


Fig. 3.—Field of Two Oppositely Charged Discs.

circular disc was employed. We may regard this as showing the lines of force round the edges of a charged circular disc, or as the projection of those from a charged sphere. Similarly we may look upon figs. 3 and 4 as illustrating the fields of two spheres when electrified with opposite, and with similar charges respectively. In like manner, figs. 5, 6 and 7, which show the fields surrounding charged strips, may be taken to represent the fields of flat plates, of which the strips are cross-sections.

In comparing these with magnetic curves, it should be remembered that in every case the tinfoil electrodes correspond with the *ends* of magnets whose cross-sections are of

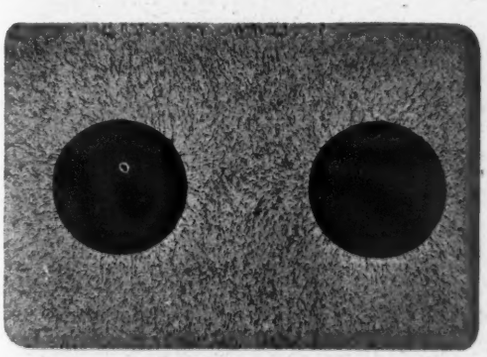


Fig. 4.—Field of Two Similarly Charged Discs.

the same shape as the tinfoil. Thus, the long strips do not correspond to magnets placed lengthwise, because the whole of one strip has a charge of the same sign, while the two ends of a magnet have opposite polarity.

When it is desired to fix the curves for future use, the upper side of the glass should be coated beforehand with paraffin wax or a mixture of wax and vaseline. This can be done by heating the plate before a fire, and then rubbing it with a piece of the wax. When sufficient has been thus melted on to the glass, and spread as smoothly over it as possible, it is placed horizontally and allowed to cool. After the wax has set, curves may be made in the same way as before, and then fixed by holding the plate before the fire again until the wax melts, keeping it level until it has again set. A cover glass should then be placed on this side, and the whole bound up like a lantern slide.

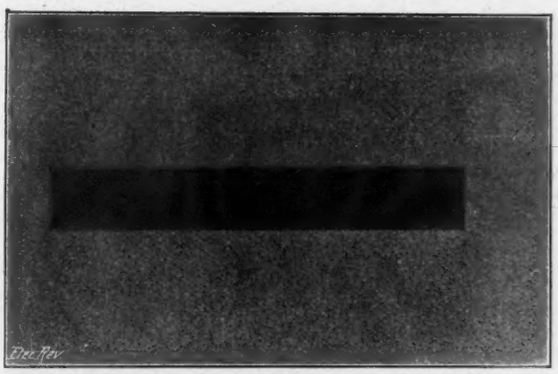


Fig. 5.—Field of a Single Strip.

The waxed surface offers more friction than the plain glass, but in spite of this, nice curves can be obtained and fixed in this way.

The behaviour of the dust may be explained thus. Suppose we have a number of conducting particles lying on an insulating surface, and near to it an electrode charged with positive electricity. Each particle will have a negative charge induced in its near parts, and an equal positive charge on its further ones; and since the field tends to separate these as far as possible, each particle will tend to set with its longest axis in the direction of the field at that place. We may therefore draw them in that position. It will then be seen that when

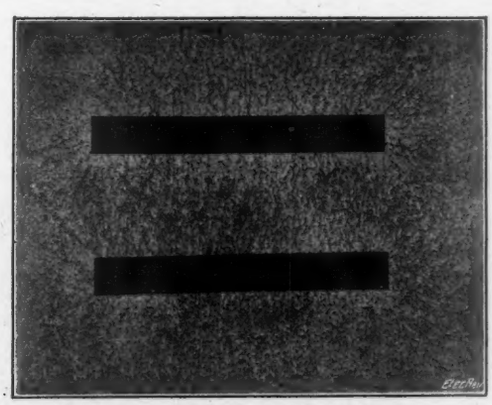


Fig. 6.—Field of Two Oppositely Charged Strips.

two particles are exactly abreast, as at A (fig. 8), they will repel one another; but if one is a little ahead of the other, as at B, they will attract one another, and so tend to draw into line, with the result that curves are formed which show approximately the direction of the force at each point. Evidently it is preferable to have long-shaped particles, so as to let the opposite charges get farther apart, and to allow each particle itself to indicate the trend of the field. Since the attracted negative is closer to the electrode than the repelled positive, the attraction will be greater than the repulsion, and there will be a slight tendency for the particles to move towards the electrode under the conditions of the diagram. So far this explanation is on the whole the same

* See *Proc. Roy. Soc.*, Edin., 1898-99, page 361.

make it more visible. Many other materials, such as tea leaves and oatmeal, will also do. When glass is used for

as for magnetic curves, with the substitution of + and − charges for N. and S. poles. With magnetic curves the drawing in of the filings towards the poles is very well marked.

There is, however, an important difference. The poles of a magnet cannot leave the metal, and every filing must have equal N. and S. poles, but it is possible for the electric charges to leave the particles, and to have a particle with only one charge on it. Now, in our experiments, the tinfoil is slightly below the level of the dust owing to the thickness of the glass. The attracted charge on each particle will, therefore, keep towards the *under* side of its nearer end,

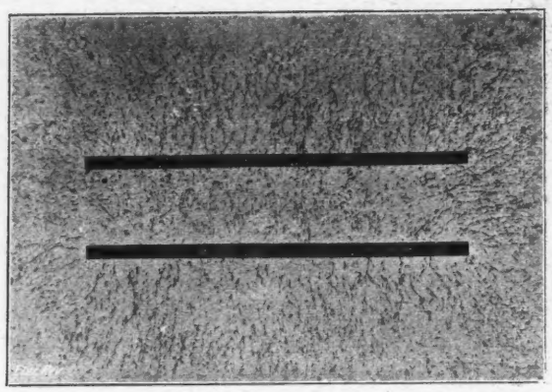


Fig. 7.—Field of Two Similarly Charged Strips.

while the repelled charge will take the *upper* side of its further end. Consequently, the attracted charge is more liable to be deposited on the glass. There would then only be repulsion, and no attraction, and so the particle would be driven away. This explains how the dust flies off, and why it does so most energetically above the tinfoil and its immediate neighbourhood, where the force has a large vertical component. This vertical component might, of course, be eliminated, except on the top of the tinfoil itself, by placing the tinfoil side upwards, so that the dust and tinfoil come on the same side, but other difficulties then arise with the connectors, and from the fact that the dust is in actual contact with the electrodes.

There is also the possibility of charges passing from one particle to the next, and for both these reasons we do not wish the material to be too good a conductor, at least, on the surface, and yet it must be a conductor to allow the

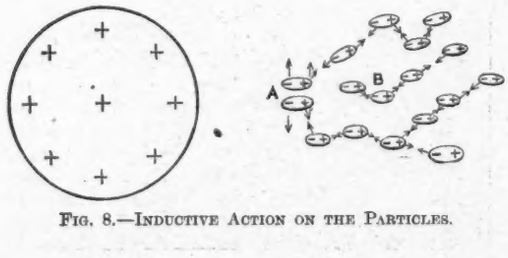


Fig. 8.—Inductive Action on the Particles.

induction to take place. In fact, a conducting kernel within an insulating shell would be an ideal type of particle to employ.

Again, when the electrodes are strongly charged, the electricity creeps over the surface of the glass, and so increases indefinitely the extent of surface actually acting as electrode. This is why we do not get results if they are charged beforehand.

The forces concerned are thus much smaller than with magnets. Hence much more care is required, and the curves are not so strongly marked as the corresponding magnetic ones. Cases with two oppositely charged electrodes, such as figs. 3 or 6, give the largest forces, and are therefore the easiest to obtain, while those with two like charges do not as a rule come out so sharp.

A NEW METHOD OF STARTING THREE-PHASE INDUCTION MOTORS.

By W. G. RHODES, M.Sc., M.I.E.E.

The *Electrical Review* (New York) for August 15th, 1900, contains a description of a new method of starting three-phase induction motors, due to Herr J. Fischer-Hinnen, and employed by the Krizik establishment in Prague.

The method consists in, instead of using the ordinary non-inductive resistances in the rotor circuits, inserting a parallel arrangement in each rotor circuit, one branch of which is a non-inductive resistance, while the other branch has small resistance and large inductance.

It is stated that at the moment of starting, the coil of large inductance acts in all respects like a very high resistance, and the two coils act together in much the same way as would two large resistances in parallel. As the speed increases and the frequency in the secondary circuit diminishes, the apparent resistance of the inductive coil diminishes and the large ohmic resistance is thus shunted by an apparent resistance of constantly decreasing magnitude. Finally, when full speed is attained, the total apparent resistance of the starting system is sensibly equal to the ohmic resistance of the inductance coil.

The only advantage of this starting arrangement appears to be the avoidance of cutting-out the starting arrangement after full speed is attained. The apparent resistance and inductance of the parallel arrangement are given respectively by—

$$R = \frac{\omega^2 L_2^2}{R_1}$$

$$\omega L = \frac{R_1^2}{\omega^2 L_2}$$

where $\omega = 2\pi n$, n being the frequency of the rotor currents,

L_2 = the self-induction of the inductance coil,

R_1 = the resistance of the non-induction coil.

This result is obtained on the assumption that the ohmic resistance of the inductance coil and the self-induction of the non-inductive resistance are negligibly small.

From this it would appear that a further displacement of the rotor currents behind the induced rotor E.M.Fs. of an angle δ, would take place, where δ is given by

$$\tan \delta = \frac{R_1^3}{\omega^4 L_2^3}.$$

Now R_1 is constant and fairly large, while ω diminishes as the speed increases. The value of δ would thus be greatest when the speed of the rotor is a maximum. At any period of the motion there is an increased lag of the rotor currents behind their corresponding E.M.Fs. which has a deleterious effect, not only in decreasing the starting torque, but in decreasing the power factor of the motor at all times.

The method should not produce results as good as can be obtained by the use of a non-inductive resistance alone.

It is obviously an advantage if a starting arrangement can be used, which practically cuts itself out automatically as the motor runs up to speed, but I venture to think that this advantage is more than balanced by the disadvantage of a diminished power factor and a diminished starting torque.

CORRESPONDENCE.

Y.J. in G.B.

On Saturday last I was busily engaged smoking my pipe, and lazily perusing the current week's technical journals. I must have been dreaming, for it seemed to me that I was wafted across the herring pond and was reading a "Yellow Journal." Could it be that I had assassinated somebody, or that I was a candidate for the Presidency? Yes, it must be either one or the other, for surely I was reading a most vituperative article on myself. But no, after all, on turning the periodical over I found it was the familiar Electrical Review. But what could the article be about? What had I done? I began slowly to recognise that I had committed a great crime. I had written a paper!

When it is desired to fix the curves for future use, th- diagram. So far this explanation is on the whole the same

It would seem, when simmered down, that the sum total of the criticism is that my critic and I do not agree on certain points, and, as he states, some of my suggestions lack originality. In the first place, my critic appears to make a great point that the best method is to bunch overhead wires, say, every quarter of a mile, and to run them below the level of the road across the track in a drawn-in conduit. He does not say whether he would insulate them. Later on, he mentions multicore cables overhead, so the presumption is that in the first instance he refers to multicore cables underground. If this be so, then his criticism errs where he claims that I have, viz., lack of originality. This point of laying underground crossing telegraph or telephone wires was the method stated by myself in the paper to be the best and most desirable. But surely my critic knows something of the Postmaster-General, and, knowing this, must know also that His Majesty will not deign to consider such a proposition as multicore cables above or below ground.

Then again I read, "Mr. Quin is wrong, surely" ("surely" is a very comforting word), "when he states that wooden strips are largely used as a protection against falling wires." Does my critic dwell in an office, and dream of overhead systems of traction, or does he visit towns wherein overhead systems exist, and if the latter, does he use his eyes? Now it seems, according to my critic, that if these wooden strips are used it would be contrary to the Board of Trade's orders. I will leave the engineers of the lines where these strips are used to settle that matter with the Board of Trade; but I happen to know that the Board of Trade have approved wooden strips in the case of Aberdeen, and that in Liverpool, at the time my paper was written, guard wires had in certain parts of the line been replaced by wooden strips with the approval of the Board of Trade. Also many of those attending the M.E.A. Convention, and who heard my paper, stayed during that visit in Leeds, in which town also wooden strips were used along parts of the line.

As regards the question of unsightliness of hammocks, this of course must be largely a matter of opinion. To me it seems that guard wires *along* a street are not so unsightly as a hammock and a bunch of wires *crossing* the street. The meshes of the hammock could certainly be made smaller than the two to three feet which I mentioned, but this two to three feet is the size which I have seen adopted in several instances. But if we make the meshes smaller we bring the hammock more into prominence, and therefore render it more unsightly.

I will, with your permission, Mr. Editor, now deal with my critic's criticism of the suggestions contained in my paper.

1. The erection of two guard wires 18 inches apart, and 2 feet maximum above the trolley line.

My suggestion was 2 feet *minimum*, not *maximum*, and my critic's statement that this is not original, and that the Board of Trade would see that it was carried out is not correct. The dimensions of guard wire supports required by the Postmaster-General are 16 inches apart, 18 inches minimum, 3 feet maximum. The Board of Trade have no standard.

2. Stipulates that a falling wire must not be able to cross an unguarded length of trolley wire.

This may appear obvious, but it nevertheless requires attention, as in several cases which have come to the writer's knowledge, a guard wire length was not sufficient to protect the trolley line from a falling telephone wire which broke close to one support, and was blown horizontally before falling.

3. Each span of guard wire shall be separate and distinct from its neighbour, but metallically looped across.

My critic deems this unnecessary, and further states that to be carried out logically would mean that every span was anchored back to the next pole at either end. This is sheer nonsense. In order that each span may be distinct, it is simply necessary to have two supports on the one guard wire standard, and that the guard wires shall be fastened to both, and bridged over by the tailing pieces of wire. My critic goes on to add that a limit should be set to the length of guard wire, say, three or four spans. He lets himself down, however, very gently by adding that "it is necessary to bind or clamp the wire to the support." Is it not preferable that he should have a double bond or clamp, and this is practically what my suggestion implies.

4 and 5. No insulators to be used, and terminals of each length of guard wire to be bonded to the rails.

Quite right, my dear critic, it is absurd to insulate, but where have you been living all this time not to know that it has been until quite recently, even if it be not now, the practice to insulate? Have you not heard of the town where they have an unpaid bill filed carefully away, which bill was the consequence of insulating guard wires? The bill read:—

To one telephone exchange complete £700

Quite recently I was connected with a certain tramway undertaking in which the engineer for the tramway company insisted upon insulating his guard wires, and when I, on my part, insisted that they should be earthed, he simply clamped them to a supporting post which was bedded in concrete, and had about 15 feet of roadway between it and the rails. Of course, my dear critic, you will be quite at liberty to support your guard wires by means of pieces of porcelain or china, but so long as these pieces of china or porcelain do not insulate the guard wire, they cease to be insulators.

6. Now as regards dividing the trolley line into sections, I am not *quite* such a fool as to be unaware that the Board of Trade insist upon sections not longer than half a mile, but what does this Board of Trade requirement mean? I may have a length of line of five miles, and have no feeders other than the trolley line provided I put a section insulator and a bridging switch at each half mile. But of what use in this case would be maximum current cut-outs per section? They would have to be in series, and on short circuit at the far end of the line the whole lot would come down. It would be obvious even to you, my dear critic, had you thought for one moment, that you cannot effectively use the maximum current devices "suggested" by myself, unless your sections are fed in parallel and not in series; and this being so, it is a suggestion outside the Board of Trade's requirements. I would also ask you, dear critic, how, if you cannot predict with any degree of accuracy the maximum working current of a section, you can calculate the feeders of your system?

7. My critic deems it doubly difficult to persuade His Majesty of St. Martin's-le-Grand to place a fusible metal bridge across the disconnecting shackle which I suggested should terminate the span of overhead crossing or telegraph wires. This is not so.

Apologising for trespassing so much upon your space.

Robt. C. Quin.

Corporation Electricity Works, Blackpool,
September 1st, 1900.

Conduit v. Trolley.

I am not an engineer, an electrician, nor an underground faddist, but just the ordinary ignorant, but fairly conscientious, town councillor.

As such, I should not like to get out of my element by plunging into a technical discussion, if it were not that your criticism of Mr. J. Allen Baker's remarks savours so much more of the heat of politics than the calm of science.

1. Dealing with loss of electricity in working, you say that it is possible to insulate an overhead wire more effectually than an underground system. No doubt; but is this to the point? Mr. Baker, and subsequently you yourself, refer to the ordinary overhead installation with an earth return, and all figures as to cost, and all arguments as to sightliness fall to the ground if you add another lot of wires in order to get this ideal insulation.

2. You blame the County Council because it has not made a personal examination of the conduit system in certain towns.

In some cases, no doubt, ocular demonstration is necessary, but I venture to affirm that all the members of the L.C.C. can read if they cannot write, and that nothing would be gained by their going on a kind of electrical beanfeast at the public expense.

I believe, however, that many members have privately examined many of the systems you enumerate, and the Highways Committee has gone so far in this direction, as in my opinion to waste a considerable amount of time at the Light Railways Exhibition, examining into matters such as the shape of a yoke, best left to our electrical advisers.

to obtain, while those with two like charges do not as a rule come out so sharp.

I done? I began slowly to recognise that I had committed a great crime. I had written a paper!

3. You say that Mr. Baker is utterly wrong in his estimate as to comparative costs, and that, as a matter of fact, example has shown that conduit costs about double overhead.

I speak as a fool, but as I understand it, London does not stand on all fours with other towns. The cost of the necessary street works is in either case so much greater than elsewhere that the difference between the two systems becomes comparatively small; particularly when the requirements of Kew and Greenwich are taken into consideration.

4. You assert very dogmatically that there is not more electrical plant in an overhead system, and that therefore it is not to the interests of electrical manufacturers to advocate the trolley.

On this I am content to rejoin that even admitting the premise, it is insufficient for the conclusion, which is affected by another item, viz., the fact that electrical manufacturers have the experience and plant requisite for producing the stock pattern trolley car, posts and wiring, whereas the conduit is to the majority an untried field, where knowledge and capital have to be laid in afresh.

Finally I would point out that your article, this letter, and any others that may appear, have unfortunately no practical value, as nearly all the London road authorities decline to allow the Council to erect overhead wires, and one of the largest parishes so outbakers Baker on the conduit, that it nearly spilt the whole apple cart on the question of allowing the Council the option of experimenting with surface contact.

A Member of the Highways Committee.

You really are a little optimistic! In your article in last Friday's issue you labour to prove that the Liverpool accident does not justify an alarmist attitude. Very well, let us grant this (though in some quarters it may be combated).

But what about "the minor and subsequent mishaps in the same town, *luckily* unattended by any injuries to passengers or passers-by, the result of what with a horse-drawn car would be termed furious driving . . . . and would have happened just the same if the conduit had been used instead of the overhead method?"

Will you be good enough to say whether the account in the *Daily Mail* of the 25th ult. is to be believed or not? If the former, I cannot understand your statement above quoted. A span wire comes down, the car driver tries to twist it out of the way, and apparently has a narrow squeak of realising an insurance policy.

Another accident. A trolley jambs in a frog and the trolley standard is wrenched out of the car, "several ladies and gentlemen having narrow escapes!"

Really, Mr. Editor, if these are accidents that "would have happened just the same with a conduit system," I am almost forced to think that if I were to take the trouble (which I don't propose to do) to look up in the index of your journal for Mr. Baker's "case after case in recent years," I should find the same paucity of information (as compared with the reports of a newspaper which has avowedly taken up the case *for* the overhead trolley) as I do in your present issue.

That happy word "luckily" contains the pith of the whole thing. I seem to remember stories about trolleys getting entangled in span wires and bringing down the whole network into the street, and trolley standards leaving cars, to the imminent danger of the public, at other places than Dublin, Bristol, Leeds and Liverpool, "*luckily*" unattended by any fatal injuries. May I always be among the lucky ones.

However, no one wishes to deny that such accidents are rare, and will probably be rarer; only why try to minimise them as though we were afraid of them?

A. W. Taylor.

[The mishaps to which we referred were caused, we were informed, by cars missing the points.—Eds. Elec. Rev.]

Destructor Tests.

In your issue of August 31st we observe you give a *résumé* of tests purporting to have been made at *Hyde* in destructor cells. Now as we are interested in Hyde (this authority having passed our plans and specification *for the erection* of a set of destructors in connection with power plant for sewage pumping) we should be glad if you will correct this, as it is calculated to do us considerable damage. We *presume* the remarks apply to Ashton-upon-Lyne, where we believe tests have been made recently, and the figures you give as to steam used in the blowers leads us to suppose that this is the installation you have in view.

As to steam consumption, it is true that the destructors of the type referred to in your paper consume a large proportion of the steam, but this is not so in the case of ours, as we think we know how to make a blower which is designed to use the minimum of steam, and in actual guarantee of destructor work, 15 per cent. has been demonstrated as the steam required for the blowers, and as in nearly every case we get considerably over 1 lb. of steam per pound of refuse, there is still well over 1 lb. of steam left for useful work, after all we require for our blowers, *i.e.*, for creating a draught for destroying the refuse and making it into an innocuous clinker.

As you have been so persistent on the pessimistic side of the destructor business, we venture to suggest that you should send an expert down, either to Hereford, Rochdale, or Darwen, without previous intimation, and ascertain for yourself that what we claim is not such a "fairy tale" as your readers will, we fear, be led to suppose from the very disparaging remarks made on this much-discussed question so frequently, as truth will, we feel sure, be found much nearer what we claim than what we suppose you insist is the actual result of "destruction" generally—ours included.

For **Meldrum Bros, Limited,**

John W. Meldrum, *Director.*

Manchester,
September 4th, 1900.

[We have much pleasure in inserting our correspondent's letter, but our attitude toward dust destructors *per se* seems to have been quite misunderstood. We wholly approve of destructors, but not of the extravagant claims so often made for them in connection with electricity production.—Eds. Elec. Rev.]

The Paris Conference.

The simple fact that I was unable to be present at the conference in Paris and to listen to the interesting discussion in three languages on alternating and continuous currents and their interference with other interests is, I think, sufficient to account for the pleasure I have derived from reading your excellently lucid report of the proceedings.

There was a time when I lived, moved and breathed in the battle of the systems and feared that a peace or even an armistice would deprive me of that stimulus which was growing into a primary condition of continued existence.

That was the time when crowds gathered at 22, Great George Street and came away wiser and more hilarious than they went in; but 10 years have worked a great change, and now we find the old combatants, or some of them, as tame as lambs and far more anxious to nibble each other's clover than formerly they were to comb each other's wool.

The discussion is disappointing by the absence of facts, though fears and fancies abound. Mr. Ferranti wonders whether it will be possible to maintain any kind of metal work under ground when the continuous current system shall have achieved its possibility; but no facts were forthcoming as to the actual effects produced by return currents controlled by the Board of Trade rules. I think we may therefore safely assume that up to the present time no serious complaints have been made by the owners of gas and water pipes.

Our American brethren have had plenty of painful experience in this direction, but they did not dilate on it, though it is a matter of common knowledge that their previous practice would have petrified our Board of Trade. They know, and we scarcely need telling, that 70 volts on the prowl mean mischief, but we are still asking whether 7 volts spells "safety" or "solution."

The rule of three, which puzzles many people, does not help us. Your panther and your pussy are both cats, but the rule of three cannot tell us how many pussies are equal

thus is practically what my suggestion implies.

the shape of a yoke, best left to our electrical advisers.

to one panther. This question would have to be settled by experiment.

Our own Sir William, as usual, spoke with authority, and settled the telephone question in a sentence. The telephone now takes care of itself, but in the bad old days, when it used to state "the earth is for Forbes," things were different, we lived the life of a dog—but we scored sometimes, for on one occasion I burned down a telephone station and paid for it.

Prof. Crocker scorned leakage and said, "If leakage took place underground at several thousand volts it would produce a short circuit." My experience shows that the leakage in the "outer" due to copper resistance is not to be despised when there are earthed telephones. An infinitesimal leakage of alternating current will play tunes on the whole telephone system. In one case I entirely failed to stop the leakage, but succeeded in neutralising the effect by bonding all the conduit pipes throughout the town.

Sir William Preece spoke of the danger of the Ferranti or momentum effect disturbing the electrical signals of railways. I think, but will not affirm, that such danger is remote, but on the other hand, I have abundant evidence that it is always necessary to use a metallic circuit for these signals in proximity to an electric tramway. In 1879 or 1880, I fitted up a system of electric light for the London & North-Western Railway Company at Holyhead with earth return; the signals were forthwith rendered unworkable, but were rectified by metallic circuits. The influence extended four miles from the harbour.

Prof. Ayrton described an interesting experiment by Mr. Trotter on the electrolysing effect of alternating current which proved conclusively that serious danger may exist; therefore, as it is possible that alternating current may be used at an early date, it is most important, as Prof. Ayrton said, to determine under what circumstances alternating currents do or do not set up electrolysis.

The learned professor also referred to the much vexed question of the influence of electric railways on magnetic observatories, and it is particularly pleasing to learn from his lips that a method of distribution has been devised that will satisfy both sides. Incidentally he lets out that he is still quite at sea as to the distribution of "*interests*." Surely in a matter of this kind the Board of Trade would not for one moment consider the "interests" either of the professors or of the promoters, their goal would be the "interest" of the public, and it must be obvious to the most elementary mind, that, to the millions who live and desire to move about in London, an electric railway is of infinitely greater importance than any number of magnetic observatories. If, therefore, it should be found impossible to have both in the same city, the observatories would have to seek a less fluttering field for the collection of stray currents, the wireless telegrams of the solar system.

Dr. Kennelly did not hesitate to express the same conclusion in more vigorous language; he said "the worst that could happen was the banishment of the magnetic observatory to the furthermost recesses of the Continent. This might be a disadvantage in some respects, but a distinct gain to the community." I can assure Dr. Kennelly that the compensating advantages would have to be superlative to reconcile us to the banishment of Prof. Perry and Prof. Ayrton from the land, and the lads that love them; the observatory would have to go by itself!!

Sir William Preece wanted to discuss periodicity, but as the conference had not a few weeks to spare, it went undiscussed.

Mr. Arnold, of Chicago, said that in railroad work they started in America with 500 volts, and gradually increased to 600 and 700 volts.

It is to be devoutly hoped that nothing of the sort will be done here. We have now settled on a pressure that suits both traction, lighting, and general power work, and we want to stick to it for a few minutes until we can see some use in making a radical change.

Dr. Thompson remarked on the "interference" on board ship, particularly with continuous current. It is interesting in this connection to recall the fact that all the early ship lighting was done by means of low pressure alternators. I abandoned the alternator in favour of the compound continuous dynamo, and the two machines of 18 KW. made by Siemens for the *Arizona* were the first practical compound dynamos produced, but to-day I would light a ship by alternating current.

John Raworth.

2, Queen Anne's Gate,
Westminster, S.W.,
September 3rd, 1900.

WIRING RULES.

THE attention which was focussed upon regulations for the erection of interior wiring by the papers of Messrs. Wordingham, Pigg and others before the Institution of Electrical Engineers, and the sundry comments in the technical press upon the question, together with the practical education of the Fire Office surveyor, as he had more and more to do with actual examples of different kinds of wiring, have led to a marked improvement in the requirements of some of the more go-ahead insurance companies, as evidenced by their printed matter. The Royal Insurance Company has just issued a valuable supplement to its rules, which embodies excellent advice—advice, by the bye, often tendered by the supply companies' wiring inspectors, but seldom accepted with gratitude by either the wiring contractor or the consumer.

For example, one has only to walk along a London shopping thoroughfare to find incandescent lamps dressed up with flimsy lace or fancy paper shades, in many cases touching the glass bulb or in very close proximity thereto. These rules point out that in drapery warehouses there is a special risk of fire originating from lamp bulbs being arranged by window dressers in contact with flimsy goods. We wish, for the sake of the business, that principals and managers could only be got to understand and fully realise the risk run; too often they think that the "inspector must say something," and that on this account alone an objection is made.

Then, again, comes the question of fuses, switches, and meters. The insured is warned that these should not be arranged where goods can be stored against them. The suggestion is made that an inclined shelf should be fixed in front so that goods cannot be stored against them. Coverless cut-outs are often found in an old installation. This is very properly condemned. It is further urged that in the case of arc resistances, the position chosen should be such that if they become red hot they will not endanger their surroundings.

In breweries and distilleries, cold stores, and other special places where damp is always present and the air moist, it is recommended that the wires and cables be run in damp-proof tubes or upon china insulators, or as lead-sheathed cables with the sheathing protected by varnish to preserve the lead. The lay-out should be on a *true* distribution-board system without joints on the conductors anywhere. This shows the thoroughly practical character of these rules. In only solitary instances does one ever see the true distribution principle. The wireman apparently either cannot or will not get rid of the notion that although he has been in the business 5, 10 or 20 years, his joints, made with so much pride and satisfaction, are weak, and the insulation—pure rubber and some sticky stuff—a mere make-believe and patchwork of nastiness.

"Electrical organs" are included. At first sight this may appear strange, but it shows that the compiler had met the individual who, by his actions, apparently considered that, because an organ was not driven by a large motor nor embodied electrical apparatus of a much heavier type than he was accustomed to in electric bell work, therefore the leads to the organ might as well be the cotton-covered single No. 20 or No. 22 he took out of stock for bell jobs, ignoring the fact that the conductors were connected to street mains at, perhaps, 220 volts. Everyone who has had to do with electro-medical work knows the same thing, and articles on "Current from the Main" are necessary if medical men and those they employ are to realise that there is only too good ground for Mr. Mordey's condemnation of the design of electro-medical apparatus, equal condemna-

resume of tests purporting to have been made at Hyde in destructor cells. Now as we are interested in Hyde (this

the rule of three cannot tell us how many pussies are equa

tion generally applying to the wiring in the surgery or operating theatre by which electric power is brought in from outside up to the apparatus.

Telephones, bells, &c., are liable to be damaged nowadays by leakage currents to the aerial lines connected to them and suitable precautions are suggested. The most obvious of these is a fuse at the point of entry of the signalling line and the keeping clear of all gas pipes for "earths." In like manner a warning is given that attachments for trolley wires or similar lines to a building should not be made within 12 inches of any gas pipe or earthed metal work. We would go further, and say that metal work not intentionally made alive should be efficiently and permanently earthed to an independent and suitable earth plate at the expense of or by the persons erecting the rosette or other attachment. Partially insulated exposed fastenings are always liable to be charged up to a dangerously high pressure if the proper insulator is damaged.

Perhaps one criticism might be made on the suggestion that charcoal is an insulator used for packing conductors where they pass in and out of cold stores and ice factories. A heat insulator it is, but the wording would lead the non-technical man to believe it was also an electrical insulator.

The requirements as regard motors are perhaps just a little stringent, and merit Mr. Mavor's sarcasm, that a gas engine may be permitted without risk where a motor is dangerous, a remark appreciated by the "Electricals" when uttered. We hardly think that the motor itself is such an offender. The true remedy for troubles is the avoidance of faults and their removal should they come on, and it is therefore pleasant to notice the suggestion and diagram of earth leakage detector lamps to be used on large *private* installations.

The regulations affecting electric kettles and heaters are sensible, and much less onerous than those in force, say in Manchester, to which we have alluded occasionally. Perhaps the most valuable—at least the most generally applicable—advice is contained on the last page as a kind of postscript. It deals with the "Increase of declared pressure of electric supply," and should be read and digested by all contractors and station engineers who are engaged upon "conversion" work, whether insured in the "Royal" or not. Altogether the rules are most satisfactory from the technical point of view, and contain little that the electrical engineer need dissent from.

THE DEVELOPMENT OF FLY-WHEELS.

Those interested in fly-wheels may read with interest and instruction an article by Mr. C. H. Benjamin in *Cassier's Magazine* on their development. What this teaches is, perhaps, more in a negative than a positive direction, for by pointing to failures it tells what to avoid, and indicates the direction in which safety must not be sought. The ideal fly-wheel is, of course, that which holds itself together by pure ring strength. Fly-wheels, as commonly made, do not hold together in this simple manner.

A very large number of fly-wheels consist of so many spokes or arms held into a central boss, and carrying at their ends each a segment of the wheel rim. Each bit of rim extends a small arc on either side of the arm, and these short pieces of rim when whirled through space are in the position of beams fixed at one end and free and unsupported at the other, the piece itself constituting a uniformly distributed loading. Each free end is, of course, more or less firmly connected to its fellow abutting free end, and in this way it receives some additional support, but does not become homogeneous or at all the equivalent of a solid ring. Other wheels consist of arms to which the ends of segments are bolted.

In this system the segments become uniformly loaded beams fixed at each end and more or less continuous over the piers or supporting columns. The connection to the arms may be such as to give a considerable ring strength, but the joint falls more or less below the solid ring in strength. The rigid connection of the arms to a non-homogeneous rim is such as to very seriously complicate the stresses, and it is very doubtful if even an approximate calculation is possible in the case of such a built-up wheel. When a wheel revolves its rim stretches to a larger diameter under the influence of the centrifugal or ring tension, but do we know that the arms have stretched to the same amount? It is very certain that they do not. The boss of a wheel is of some considerable diameter, and more or less massive build, and it revolves at a comparatively low linear speed, and does not expand much. The arm is only part of the radius in length, and therefore expands less than the rim. Stress is thus thrown on the arms which are compelled to carry the rim, and this is thereby constituted a series of arcs held down to piers and uniformly loaded. Such a wheel tends to fail at three points in general, viz., by cross breaking stress at the centre of each segment or midway between the arms, the rim opening on its outer circumference; by cross breaking over each arm, the rim opening on its inner circumference; by tension at the arm end, the top of the arm pulling off under the centrifugal pull of the rim segment.

The ideal fly-wheel is, of course, that formed of high tension steel wire wound in continuous coil. Such a rim does not require to be connected with the arms, excepting so far as is necessary for the transmission of rotary stress. In such a case the arms transmit only a stress that tends to break them across as beams fixed at one end only and loaded at the other. Such arms ought to be capable of being calculated as to strength with fair approximation and so also should the rim, which, having no points of support, is not subject to complex stresses, but simply to a ring tension. In American practice failures have been very frequent, and have led up to the wooden wheel built up of an enormous number of carefully selected clean-grained pieces of wood, carefully glued and cross-jointed.

Fly-wheels have been designed with their rims closely supported by a large number of tension spokes, after the manner of a bicycle wheel. This class of wheel depends for its strength on the resistance to tension of a spoke of high-class steel, loaded with a lump of cast-iron. The cast-iron rim is so closely supported in the ideal wheel of this type that no cross breaking can occur. Each short bit of rim may be considered as a separate piece of cast-iron held to its own tension spoke, and receiving no support in the way of ring tension from any other part of the rim. Up to its limit of elasticity cast-iron stretches more than wrought-iron or steel, and the two materials cannot be combined in the ratio of their strengths, but must be combined in proportion to their extension coefficient per unit area. Thus the bolts of a cast-iron bridge arch which connect the segments are proportioned to suit the relative extensibility of cast and wrought-iron or steel, and are made larger than they would be if tensile strength were alone in question, but smaller than equality of area would demand.

So in a cast-iron rim with frequent wrought-iron spokes, the rim is entirely constrained by the spokes, and cannot act by ring tension. The ring tension of a cast-iron rim may come in in case of a rope or belt pulley of large breadth with only a simple set of central arms. The outer edges of the rim derive no support whatever from the arms, but tend to rupture, in one way, by ring tension. In doing so, each short transverse section of rim may be looked on as a cantilever fixed at one end, that is, at the middle breadth of the rim, and free at the outer edge, except for the restraining effect of its connection with all the other sections with which it tends to act as a ring in tension. The stresses thus set up are most complex in their nature, and are only to be satisfactorily dealt with by elimination to a safe point, an operation usually confined to duplicating the arms, and reducing the overhang of the rim beyond the arms to such a reasonably small amount as will bring into action the support of the arms. Some American power houses have used steel wheels built up of steel plate and rivetted angles, and supplemented by wire winding as referred to above. Such wheels must have a very large margin of safety at any speeds hitherto attempted.

Though many wheels are very weak in their construction, the accidents have not, on the whole, been numerous; but this is rather a tribute to the goodness of the governing than to the care of the designer of the wheel. Most bursting that have taken place have been caused by excessive speed, the customary safeguard against which, in English practice, has been the knock-off motion, which closes the engine valve suddenly as soon as the speed of rotation exceeds or falls below a certain narrow limiting range. The idea at the bottom of the knock-off motion was not entirely one of safety. Its place of origin was Lancashire, and while safety may have had something to do with the knock-off at the higher limit, it was to avoid the production of soft or fuzzy yarn that the knock-off was also made to act at the lower speeds that are known to be productive of such faulty yarn. The Allis Company, of Milwaukee, make a wheel that has cast-steel arms treble bolted to a cast-iron hub and rivetted to a rim of steel plate with joints so well broken as to be of a strength of seven-eighths the maximum.

In designing a fly-wheel it should be borne in mind what the duties are that have to be carried out. A force is exerted by the shaft in excess of the mean work to be done. The result is acceleration. The surplus force is passed from the shaft through the keys to the hub, thence to the inner ends of the arms and by cross-breaking stress in the arms into the rim. The rim moves somewhat more quickly, and in doing so stores up the surplus energy put into it. In a brief moment the force that rotates the shaft falls below the mean resistance of the driven machine, and the shaft begins to run more slowly. It would run very much more slowly were it not securely attached to the fly-wheel. The rim of this endeavours to maintain the velocity impressed upon it, and in its turn presses on the arm ends; these again urge forward the hub and through this and the keys, the shaft, which is thus kept revolving at a speed that never falls above or below its mean value by more than a certain fraction that is fixed by the relation of the weight and energy of the wheel rim to the maximum fluctuation of the resistance or the driving power. The latter fluctuates from a maximum to zero at every stroke in a single cylinder or tandem engine, and an engine tends to vary its speed of rotation every half revolution from this fluctuation in the driving energy as well as with every change in the driven resistance.

The limit of fluctuation is thus very much a question of fly-wheel energy more or less compounded with the excellence of action of the governor. The stresses in the arms and keys are reversed and reversed with great frequency, and the shaft of any variable load engine is severely stressed also. This points to the error of putting a fly-wheel on the wrong end of a shaft as is so often done in

traction work, wherein the fly-wheel is commonly put at the other side of a crank from that occupied by the generator, which is the origin of the stress variations so far as they affect the engine.

It may be laid down as sound practice that the variation of stress in a shaft must only be the unavoidable variation due to the cycle of operations in the cylinder, and that all load variation should pass to and from the fly-wheel and generator without passing through the shaft. This implies a rigid lateral attachment of the fly-wheel and the generator.

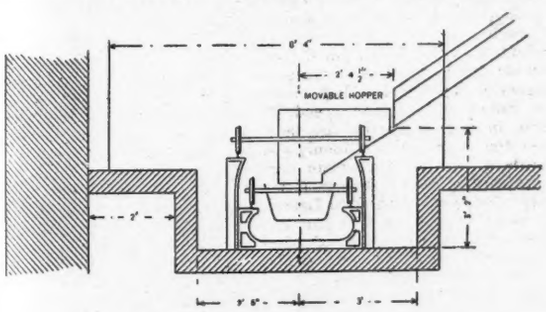
For a cast-iron wheel the solid wheel is the best, if well designed and well cast by a competent founder who can manage the cooling-down process sufficiently slowly. Such wheels are usually of small size, and they constitute, therefore, one of the advantages of the small high speed type of engine as compared with the heavy slow type for which the fly-wheel must be large and heavy, and therefore must be of some built-up type, either expensive to build safe, or liable to be of weak structure if of ordinary commercial type.

COAL AND ASH CONVEYER FOR NORTH-WESTERN ELEVATED PLANT.

THE *Street Railway Review* has received from the John A. Mead Manufacturing Company, of New York, a description of the coal and ash-handling plant it is building for the North-Western Elevated Railroad Company, of Chicago. The coal storage building is 24 × 80 feet, located on the north end of the lot, and connected with the boiler room by a tunnel, and by an overhead passageway, about 40 feet above the ground. This trestle is about 260 feet long, and the receiving hoppers are about 50 feet north of the power station; the ask tanks are just north of the receiving hoppers.

Coal is unloaded from the railroad cars directly into the hoppers, and thence passes through the crushers, which are driven by independent electric motors, into the buckets of the horizontal conveyer, which takes it through the subway to the storage house, and thence up and on to the elevated trestle. The coal is dumped into the storage house or carried on south and deposited in hoppers above the boilers; the dumping is accomplished by means of a movable dump carriage, which is operated by a separate chain and wheels, and can be set at any desired point on the upper line.

For loading ashes into the conveyer a special movable hopper, travelling over the conveyer buckets on separate tracks in the basement of the boiler room, is stopped under one of the chutes leading down from the ashpit, and the chute opened. By this means ashes are transferred to the conveyer buckets in such a manner that



SECTION THROUGH ASH CONVEYER.

they cannot reach the wearing parts of the conveyer. Once in the conveyer the ashes are carried round and up, and emptied into the ash tanks, from which they can be drawn off into railroad cars or carts. The drawing shows the ash conveyer and movable hopper.

The driving machinery for the conveyer is located on the upper line just opposite the stack; there are two drivers operated by independent electric motors of the ironclad type, one driver being held in reserve, so that, in case of accident either to driver or to electric motor, the other driver can immediately be put into service. This is also true of the coal crushers, which are duplicates, and entirely independent of each other. The length of the conveyer is approximately 1,300 feet; the buckets and links are of malleable iron, buckets of this material being the only ones that will satisfactorily handle ashes for any length of time. The capacity of the conveyer is from 40 to 50 tons of coal per hour.

BUSINESS NOTES.

Auction Sale.—On Thursday, September 20th, Messrs. Fuller, Horsey, Sons & Cassell will sell by auction at the Old Mill Works, near West Drayton, engineers' and electrical plant and machinery, including lathes, drilling and slotting machines, turbine, water motors, dynamos, electric motor, accumulators, motor car, &c.

Electrical Wares Exported.

WEEK ENDING SEPT. 5TH, 1899.			
Alexandria	..	..	Value £134
Amsterdam	..	..	25
Antwerp	..	..	40
Auckland	..	..	85
Bangkok	..	..	12
Boulogne	..	..	63
Brisbane	..	..	157
Buenos Ayres. Teleg. mat.		..	449
Calais	..	..	60
Calcutta	..	..	140
Cape Town	..	..	120
Chinde. Teleg. mat.		..	520
Christchurch	..	..	50
Christiania. Teleg. wire		..	47
Colombo	..	..	53
Copenhagen. Teleg. wire		..	89
Demerara. Teleg. mat.		..	766
Durban	..	..	1,745
East London	..	..	159
Gibraltar. Teleg. appris.		..	96
Hambro. Teleg. mat.		..	300
Hong Kong	..	..	404
Labuan	..	..	89
Launceston	..	..	58
Malta	..	..	68
Melbourne	..	..	243
Monte Video	..	..	21
Paris	..	..	165
Penang. Teleg. mat.		..	80
Port Said	..	..	27
Rio Janeiro	..	..	83
Santos	..	..	15
Shanghai	..	..	2,065
,, Teleg. wire (old)		..	92
Singapore	..	..	347
St. Petersburg	..	..	78
,, Teleg. wire		..	81
Stockholm	..	..	808
,, Teleg. wire	..	..	46
Sydney	..	..	1,092
Teneriffe	..	..	13
Tientsin	..	..	220
Wellington	..	..	221
Yokohama	..	..	18
,, elec. wire	..	..	333
,, elec. cable	..	..	138
Total	..	..	£11,349

WEEK ENDING SEPT. 4TH, 1900.			
Adelaide	..	..	Value £67
Aden. Teleg. apparatus		..	40
Amsterdam	..	..	143
Auckland	..	..	714
Bangkok	..	..	110
Beira. Teleg. mat.		..	44
Bombay	..	..	141
Bordeaux	..	..	80
Boulogne. Elec. cabs		..	150
Buenos Ayres. Elec. cable		..	725
,, Teleg. mat.		..	908
Calcutta	..	..	373
,, Teleg. wire	..	..	94
Cape Town	..	..	16
Colombo	..	..	81
Durban	..	..	388
East London	..	..	78
Flushing	..	..	16
Fremantle	..	..	60
Halifax	..	..	30
Hamburg	..	..	110
Hong Kong	..	..	9
Jamaica. Teleg. mat.		..	59
Karachi	..	..	123
Kobe	..	..	93
Launceston	..	..	214
Libau	..	..	330
Lyttelton	..	..	197
Madras	..	..	4
Malta	..	..	29
Melbourne	..	..	458
,, Teleg. mat.		..	9
Port Elizabeth	..	..	103
Rio Janeiro. Teleg. cable & mat.			188,592
Rotterdam. Teleg. mat.		..	46
St. Petersburg	..	..	184
Seville	..	..	280
Shanghai	..	..	85
Singapore	..	..	111
Stockholm. Teleg. mat.		..	242
Sydney	..	..	1,118
,, Teleg. mat.		..	404
Tokio. Teleg. cable		..	135
Trinidad	..	..	57
Wellington	..	..	30
,, Teleg. cable		..	387
,, Telephones		..	293
Yokohama	..	..	579
,, Teleg. apparatus		..	11,946
Total	..	..	£211,031

Foreign Goods Transhipped.

Alexandria. elec. apples. Value £106		Gothenburg. Elec. goods Value	£40
		Stockholm. Elec. mat. ..	103
		Yokohama. Elec mat. ..	10
		Total	£153

Bankruptcy Proceedings.—At the London Bankruptcy Court on Thursday last week, a meeting of creditors was held in the matter of Walter Vernon Scott, electrical engineer. The debtor states that for 10 years prior to 1897, he was in employment as an assistant electrical engineer. In February of that year he promoted a limited company called W. V. Scott & Co. Limited, for the purpose of carrying on an electrical engineer's business. The nominal capital was £5,000 in £1 shares. He put £100 borrowed money into the company, and was appointed managing director at a salary of £250 a year, 1,500 shares being allotted to him. About £1,700 was subscribed by the public, mostly friends of the debtor. The company went into liquidation in November, 1898, and the liquidation has been closed, no return being made to the creditors or shareholders. The debtor returns his liabilities at £725 19s. 1d., against assets *nil*. He attributes his insolvency to liability under a judgment obtained by the petitioning creditor in respect of a share transaction; and to his liability for moneys borrowed for, and goods supplied to, the company during the time that he was managing director. The matter will be wound up in bankruptcy by the Official Receiver as trustee. The following are creditors:—Lapdell, £190; Chapell, £184; Lyons, £10; Page, M,. £23 5s. 10d.; Scase, R., £30; Scott, A., £200; Simplex Steel Tube Co., £30; Watts & Nephew, £101 10s.; Webb, Ware, W., £30 7s. 3d.; Fully Secured: London and Westminster Loan and Discount Co. £60.

Creditors of Wilks, Sloan & Co., electrical engineers and contractors, 112 Bath Street, Glasgow, and John Lumsden Sloan, electrical and consulting engineer there, the sole partner of said firm, as such partner, and as an individual, will receive a dividend, November 1st.

Notice appears in the *London Gazette* of the release of trustee (Mr. J. A. Binns) in *re* A. Blackburn and J. Walker, (Blackburn, Walker & Co., electrical and mechanical engineers of Bradford.)

Business for Sale.—The electric lighting and engineering business of P. C Middleton & Co., Limited, of Aberdeen, Edinburgh, Inverness, and Cults is offered for sale as a going concern. See our "Official Notices" this week.

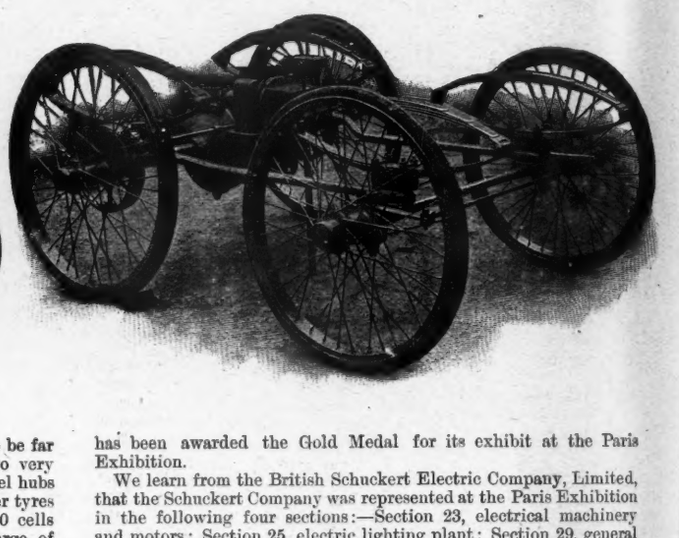
Catalogues and Lists.—The Shillingford Engineering Company, Limited, of Cheltenham, have issued a list (July, 1900) of revised particulars of the "Trusty" oil and gas engines.

The Electrical Development and Light Regulating Syndicate, of Halifax, have forwarded to us a copy of their new catalogue of electric light and power regulators for use on alternating current supply circuits. The E.D.S. regulator (protected by the patents of Mr. Walter Emmott and others) is claimed to be "the only reliable system of saving energy while turning electric light up or down like gas." The regulators can be applied without interfering with the present lamps or fittings in any way beyond substituting the apparatus for the switches at present in use. It is possible to regulate any number of lights and at any distance. For hotels, theatres and churches, the device is thought to be eminently suitable. The list

gives a plan of the internal connections of the regulators and a set of lamp curves, showing the power absorbed in watts, and the approximate C.P., at each point of regulation. A number of photographic illustrations show the regulators for use in different classes of premises.

Dividend.—September 15th is the last day of receiving proofs for dividend in *re* B. Symmons, electrical engineer, Brighton.

Electric Carriages.—We have received from Mr. Carl Oppermann a price list of electromobiles fitted with the Oppermann patent underframe and driving gear. In this system the driving mechanism is constructed on a frame quite independent of the "body." The rear axle is the driver, although if necessary the front axle can be made to drive. Mounted upon the driver axle is a differential gear which is fixed in the centre of a phosphor bronze worm wheel; into this gears a hardened steel worm, which is keyed on the end of the motor spindle. The worm and wheel are enclosed in a dust-tight gear case, which being partially filled with oil, ensures perfect lubrication for the worm. The ratio of the speeds of the motor spindle and driving axle is 22 to 1. The bearings throughout are constructed with rollers. The steering is on the Ackermann principle, a straight rack and pinion being used so as to make the steering less "jerky" than if a series of ordinary levers is used. The motor is series wound, with steel horse-shoe two-pole magnets; the armature is an improved Gramme ring with 40 sections. The commutator is made of hard rolled copper, and the brushes of copper



gauze set as tangents to the commutator; these are said to be far preferable to carbon brushes, and do not heat at all. Two very powerful band brakes acting on large drums fixed to the wheel hubs and two of Price's patent shoe brakes acting upon the rubber tyres are used to stop the carriage. The battery consists of 40 cells arranged in four boxes of 10 each, capable of giving a discharge of 25 amperes for 5 hours. The weight of the complete cell is 24 lbs. They are coupled in series in two sets of 20, and by means of the controller when in the first position the two sets are put in parallel giving 40 volts, the magnet coils of the motor being in series; in the second position the cells are all put in series, giving 80 volts, the magnet coils remaining the same as in the first position. In the third position the E.M.F. of the cells remains at 80 volts, but the magnet coils are put in parallel. These three operations give speeds of 5, 8, and 12 miles an hour. By pulling the controller lever towards the driver when at the "off" or "stop" position, the current in the armature is reversed, and the car runs backwards. At the full speed on level roads the carriage takes 26 amperes, and a run of between 45 and 50 miles may be relied upon with one charge of the battery. The frame and underworks are easily adapted to any shape of body. One of our views shows the frame, while another represents the "Lucania" electrical dog-cart, made by Mr. Oppermann.

Electric Organ.—A Hope-Jones electric organ is being erected at Llandaff Cathedral.

Fatality.—Three men in the employ of the National Telephone Company at Glasgow were seriously injured on 31st. ult. by the fall of a large iron telephone standard upon which they were engaged. One of the men has since died.

Reduction in Price of Cables.—Messrs. Connolly Bros., Limited, notify that on account of the easier tone in the copper and rubber markets, they are now in a position to allow a further discount of 5 per cent. from their February, 1900, list prices in addition to discounts hitherto allowed. This extra discount will apply to all classes of insulation, but not to the extras for lead-covering and armouring, which will remain as before. Messrs. Connolly have recently completed extensions in their plant, which will enable them to deal more promptly with orders during the coming season.

Messrs. W. T. Henley's Telegraph Works Company announce that since their February, 1900, price list was issued the cost of raw india-rubber has been reduced, and they have therefore increased their discount off the list by 5 per cent.

Liquidations and Dissolutions.—A meeting of the Eastbourne Electric Light Company will be held at Eastbourne on October 8th, to hear an account of the winding up from the liquidator, Mr. H. Towner.

A similar meeting regarding the Reason Manufacturing Company Limited, will be held at Brighton on October 3rd. Liquidator, Mr. Ernest Wright.

Messrs E. E. Prestwich, L. N. Burt, and S. A. Parkes (Prestwich and Burt, electrical and mechanical engineers, Kingston-on-Thames) have dissolved partnership. Messrs Prestwich & Burt will continue the business under the old style, and Mr. Parkes will attend to debts, &c.

Paris Exhibition.—Only a few weeks now remain before the close of the Paris Exhibition, and we anticipate that several deputations will be going from this country to inspect electrical machinery and apparatus there. For the benefit of such we may mention that a new edition of the "Anglo-Saxon Guide to the 1900 Paris Exhibition" (1s. net.) has just been issued by Messrs. Boot & Son, of Old Bailey, E.C. It contains many illustrations, maps and plans, &c., to help one to find the best way about. The great demand for the Guide has necessitated the publication of this second edition, and the editor, Mr. E. Bernard, has included a complete list of the British awards arranged in alphabetical order to facilitate reference.

Elmore's German and Austro-Hungarian Metal Company, Limited, has been awarded the Gold Medal for its exhibit at the Paris Exhibition.

We learn from the British Schuckert Electric Company, Limited, that the Schuckert Company was represented at the Paris Exhibition in the following four sections:—Section 23, electrical machinery and motors; Section 25, electric lighting plant; Section 29, general plant; Section 118, electrical apparatus for marine and naval purposes, and has been awarded in all four cases the Grand Prix. The engineers and representatives of the firm have also received nine Gold Medals and eight Silver and Bronze Medals.

The Albradium Syndicate, Limited, has obtained two Bronze Medals and an Honorable Mention at the Paris Exhibition for its new white metal, "Albradium."

Polytechnic Notices.—The day college courses in civil, electrical and mechanical engineering, and applied chemistry at the South-Western Polytechnic, Chelsea, will be resumed on October 1st.

The catalogue of announcements—educational and social—for the 1900-1901 session at the Northampton Institute, St. John Street Road, E.C., has been issued. As usual, very full details are given of the numerous arrangements, and photographs show the different class-rooms, &c. Among the new features for the session are the engineering day courses.

Trade Announcement.—Mr. S. Haynes, manufacturers' agent, has removed from 13, Castle Gate to 13, Mount Street, Nottingham, where, for the convenience of the trade and contractors of the Midlands, a quantity of accessories, cable fittings, &c., are kept in stock, including goods of the following manufacturers:—St. Helen's Cables, British Electric Works Company, Limited, all Stellite accessories, Lewis Bayliss Company's switches and switchboards, New British Electric Lamp Company's lamps, and a large selection of Messrs. C. Joyner & Company's artistic fittings.

ELECTRIC LIGHT AND POWER NOTES.

Accrington.—The Corporation has directed the preparation of plans and estimates for electric lighting in the main streets. A proposal is also under consideration for the Corporation to electrically equip the Church and Clayton section of the tramways, the Tramways Company to work the line until the expiration of their lease, which has six years to run.

Aberdeen.—The accounts of the Corporation electricity works show satisfactory progress during the past year. The revenue was £14,211, the expenditure £6,062; with £457 received from the tramway department, the gross profit was £8,606, and after paying capital charges the net surplus was £2,284. In the last two years the electrical energy generated has more than doubled.

Bangor.—The new electric lighting works are rapidly approaching completion, and it is expected will be opened some time this month. Over 1,000 lights more than it was calculated would be required in three years have already been connected. Two engines had originally been arranged for, one as a stand-by to the other, but owing to the great demand for electricity both engines will have to be kept working, and a third ordered the moment the works are started.

Bath.—The price of electricity supply has been raised ½d. per unit on account of the rise in cost of coal.

Carnarvon.—The Gwyrfai District Council has approved of Mr. E. W. J. Paterson's proposal to apply for powers to supply electricity for all purposes within the Council's area. The scheme includes the construction of a light electric railway from Carnarvon to Dinas Dinlle.

Carnoustie.—The Burgh Commissioners intend to oppose the application of the North British Electricity Supply Company for a provisional order, and to apply for one on their own account if necessary.

Christchurch.—The Board of Guardians has agreed that the plans and specification prepared by Mr. Peers in connection with the electric lighting of the workhouse and cottage homes be adopted, and submitted to the Local Government Board for approval.

Devonport.—A number of the main streets are to be lighted electrically with 47 arc and 82 glow lamps.

East Ham.—Mr. F. W. Long, a member of the East Ham Council, on Tuesday laid the foundation stone of the shaft for the new electricity station, which is being erected in connection with the Council's scheme for electric tramways and lighting.

Germany.—According to the *Board of Trade Journal*, H.M. Legation at Munich states that on the Isar, a few miles above Munich, are electric supply works, with four turbines developing 2,000 H.P., while provision is being made for a further 4,000 H.P. The creation of these works has called into being an entirely new industrial district, which is supplied with light and power by their agency. First of all Sendling was served, and now 21 other localities near Munich benefit by these works, which afford a most interesting object lesson in showing the means, where the necessary water-power exists, of removing factories, workshops, and labourers' dwellings to cheaper and healthier localities outside great cities. The experiment of the Isar works has proved a great success, as there are now 90 undertakings of all kinds, including 25 farms, supplied with light and power by them; many of these works previously sold their valuable buildings and sites in the centre of the town, bought far cheaper sites with siding connections with the railway, and built workmen's dwellings adjoining at great profit and economy in working expenses. In all there are 151 electro-motors with 1,062 H.P., and 21 motors with 267 H.P. in course of erection, besides which 13,500 incandescent lamps and 329 arc lamps are supplied with electric current. A steam engine of 1,000 H.P. is held in reserve. The electric cables measure 56 miles long, with 30 miles of secondary distributing cables. The Munich municipal electric supply works on the Isar are largely worked by turbines, with reserve steam engines, the former on the Francis system, with an elaborate system of regulators to counteract the variation of water-level. During the recent floods, it is solemnly stated, the accumulators were under water for some days, but continued to give out current!

Gloucester.—Extensions of the public arc lighting are contemplated, and the total number of private lamps connected already amounts to 9,230 (8 C.P.). According to the chairman of the Electricity Committee, recent applications bring up the total in prospect to 14,058, while the present capacity of the station is 12,000 lamps.

Goole.—At a special meeting of the District Council last week, called to consider the question of electric lighting and the notification which the Council had received that a syndicate intended to apply for a provisional order for Goole, a resolution was carried unanimously that the clerk should at once take steps to give effect to a resolution passed two years ago for the Council to apply for a provisional order, and that the clerk reply to the syndicate that they were already applying for a similar order and would strongly oppose the granting of an order to outsiders.

Hayti.—The Government of Hayti has decided to cancel all lighting concessions, paying compensation to the holders thereof, and to take the lighting of its cities into its own hands. The electric light is to be introduced into the capital at an early date.

Lancashire.—The Asylum Board has decided to grant a sum of £500 out of the Asylums Fund for the cost of an electric light installation at Prestwich Asylum, and £5,500 for a like purpose in the new infirmary buildings at the same asylum.

Little Lever.—The Lancashire Electric Supply Company has applied for a provisional order for the supply of electricity in the district.

Liverpool.—The Corporation has adopted electric lighting by arc lamps for the Fish Market.

Newark.—The District Council has instructed Mr. Vesey-Brown to prepare a report and estimate of the cost of establishing an electricity supply in the town for public and private purposes.

Ripon.—The Electricity Committee has recommended the Corporation to apply for a provisional order for electric lighting, and to employ Messrs. George Harrison & Co., as consulting engineers for the scheme, provided suitable terms could be arranged.

Roumania.—A central station has just been completed and put in operation in the town of Sinaia. The water-power of the River Prahova is utilised, and the plant has been supplied by Messrs. W. Lahmeyer & Co., Frankfort-on-Main.

Scarborough.—The new Hospital is to be equipped with the electric light.

Sheffield.—The electrical engineer, Mr. S. E. Fedden, has reported to the Electric Light Committee on the necessity for large extensions at an early date. On account of the large capital already sunk in the undertaking, Mr. Fedden is unable to recommend the adoption of direct current supply to the central area; but he strongly advises the conversion of the frequency to 50, by degrees, and the purchase of two 1,000-KW. alternators for next year, at a total estimated cost of £41,895. With the lower frequency it is hoped that a large power supply will become possible.

South Shields.—The Board of Guardians has resolved to raise a loan of £2,500 for the electric lighting of the workhouse.

Sunderland.—The Lighting Committee of the Corporation is making some very interesting experiments as to the comparative cost of gas and electricity for public lighting purposes. The Corporation owns the electrical works, and is naturally anxious to utilise them to the fullest extent possible. The experiment made with two Sugg lamps resulted as follows:—Electricity (at 2½ per unit), £7 16s. 6d.; gas (as per contract), £5 16s. per lamp. In regard to the ordinary street lamp the comparison is:—Electricity, £3 6s. 6d. as against £2 16s. for gas. The Committee is to consider the matter at a future meeting.

Warrington.—The Electric Lighting Committee has resolved that the price of electricity for motive power be 2d. per unit for the first 3,000 units per quarter, and 1d. per unit afterwards.

Worcester.—The City Council has raised the price of electricity in the case of private consumers to 6½d. and 3d., and of the waterworks motors to 4d. per unit. Two guineas per annum extra will be charged for all-night public arc lamps, 1 guinea for half-night lamps, and 5s. for glow lamps.

ELECTRIC TRACTION NOTES.

Batley.—The Electric Light and Traction Committee have agreed to an addition of £2,000 to the estimated cost in connection with the proposed installation of electric light and tramways for the borough.

Blackpool.—The *Blackpool Gazette* says that there was an unfortunate breakdown in connection with the electrical tramway system on Tuesday last week. The machinery at present in use is only calculated to generate the electricity required by 18 cars, but since the Claremont Park extension was opened it has been called upon to provide the motive power for 25 cars, and has therefore been greatly overloaded. New machinery to relieve this dangerous pressure has been on order for many months, but it has been found impossible to obtain delivery from the makers. The result was that, on Tuesday last week, one of the 100-H.P. steam turbines broke down under the strain, and the tramway traffic on the Promenade was altogether disorganised. Mr. R. C. Quin acted promptly in the emergency, and as quickly as possible made arrangements with Mr. Cameron, manager of the Blackpool and Fleetwood Tramroad Company, for the necessary supply. The Fleetwood Company has fortunately some reserve plant which it was able to place at the disposal of the Corporation. It was arranged that the whole of the electricity required on the Promenade line from the Gynn as far as the Central Pier should be supplied from the Fleetwood Company's works, while the other 100-H.P. turbine at the Corporation works would provide for the supply from the Central Pier southwards. In connection with the lighting department, also, additional machinery has been on order for some time, but all the leading engineering firms are so congested with work that it is impossible to obtain delivery without long delay. However, there will be considerable extensions all round during the winter, and when another season arrives it is understood that both tramway and electric lighting departments will be fully prepared for all emergencies.

Messrs. W. T. Henley's Telegraph Works Company since their February, 1900, price list was issued the cost of raw india-rubber has been reduced, and they have therefore increased their discount off the list by 5 per cent.

trically equip the Church and Clayton section of the Tramways Company to work the line until the expiration of their lease, which has six years to run.

Glasgow.—The Corporation Tramway Committee on 28th ult. inspected the power station in course of construction at Pinkston, Port Dundas, for the supply of electricity for the electric cars. Mr. Parshall, the consulting engineer, explained the machinery and its arrangements. There were two special cars of different designs submitted for the consideration of the Committee, and the present double-decker now on the Mitchell Street-Springburn route was selected as the most suitable for the new system over the whole city. Two horse cars, reconstructed for electric traction, were also exhibited. At the car sheds at Coplawhill five new cars are being turned out every week. Mr. Young believes that the electric system embracing the entire city will be inaugurated about the beginning of next year or shortly before the opening of the Exhibition.

The electricity works at Port Dundas and Pollokshaws Road are to be officially inaugurated on Thursday, 13th inst.

Lake District.—We had almost thought that opposition based on esthetic grounds to the overhead trolley had died out, but some writers in the London newspapers are going out of their way to protest against the use of the system in the Lake District. An attempt has been made to create a strong public feeling against spoiling the unique beauties of the district. From personal acquaintance with this part of the country we consider that a trolley line is just what is wanted for the Windermere, Ambleside, and Bowness districts, which newspaper correspondents are so fearful should be spoiled. The scheme which is now on foot is being promoted by a London company in conjunction with the Windermere and District Electric Supply Company. The Light Railways Commissioners will hold their inquiry on September 24th. One correspondent of the *Standard*, who is acquainted with the district, is rapturous in his appreciation of the scenery, and he recommends the electric railway scheme as being bound to secure public convenience and utility.

Liverpool.—As representing the shopkeepers of Manchester Street, a deputation waited upon Alderman Petrie on 29th ult., and pointed out that since the withdrawal of all tramcars from Manchester Street and St. John's Lane, the tradespeople complained of a marked falling off in custom. It was also argued that the taking away of the cars was exercising a prejudicial influence on the property. Alderman Petrie intimated that in the course of the next two months the Tramways Committee hoped to have lines laid in Manchester Street, and that then at least a third of the traffic would pass through that thoroughfare.

The City Council was on Wednesday asked to sanction the purchase from Messrs. Dick, Kerr & Co., Limited, of an additional 100 cars similar in type to those at present being supplied by that firm.

Surrey.—A syndicate proposes to ask for powers under the Light Railways Act in November next to run a light railway from Chobham to Woking, and thence to Send, Ripley and West Horsley, and from Walton to Weybridge, and thence to Addlestone. In addition to these two schemes the Kingston Town Council propose to ask Parliament for powers to construct an electric tramway in Kingston and Surbiton, to connect with the London County Council's system of tramways at Kingston Vale, and with the London United Tramway Company's system at Kingston Bridge, in Hampton Wick, Middlesex.

Tramway Schemes.—Promoters of tramway companies have been particularly active during the past year. The report of the Board of Trade, issued last week, shows that the number of applications for provisional orders was 36—the largest total since 1881. Thirty-five of these applications included power to construct new or extension tramways, only one being for permission to use mechanical power on existing lines. According to the *Financial News* the rush was due not so much to the private promoter as to the local authorities, who would appear to have suddenly awakened to the advantages of improved facilities for locomotion within their districts. They were responsible for no fewer than 27 out of the 36 applications, the total estimated cost of the tramways applied for being £1,626,307. There were but 12 applications for provisional orders for gas undertakings and one for gas and water. The amount of capital proposed to be authorised in the first case was £225,200 in shares and £58,050 in loans; in the latter the capital was £311,000 in shares and £77,750 in loans.

It is stated that a notification has been conveyed to the various Parliamentary agents who are now entering upon the preliminary work in connection with next year's private bills, that the revised clause securing better accommodation for the working classes which was inserted in the London United Tramways Bill, at the instance of Mr. Lough last Session, will be insisted upon in all future measures authorising the construction of tramways.

Wrexham.—The Drake & Gorham Electric Company have taken over the old Wrexham Tramway Company's undertaking, and will equip it for electrical working. The engineer has reported upon the progress of the electric lighting of the town which is satisfactory, except as to the underground mains and cables. The Council adopted 6d. as the charge for lighting purposes, and 3d. per unit for motor supply.

TELEGRAPH AND TELEPHONE NOTES.

Cable Communication in the East.—The operations of the Northern Telegraph Company of Copenhagen, which recently completed the laying of a new submarine cable between Taku and Chifu, and is now engaged in establishing a similar cable between Chifu and Port Arthur, seem (says the *Financial Times*) to have excited considerable discord in Russia. Not only do the Russian papers express animosity towards the company, but they charge it with having introduced excessive tariffs and with inefficient transmission of the telegrams. As a consequence they urge that the Russian Government, in order to be independent of the company, should take steps with a view to the laying of a Russian cable between the island of Sakhalin and the Japanese island of Yesso, so as to form a connection with the Japanese telegraph system. In this connection a Danish correspondent states that in Copenhagen the dissatisfaction is regarded as entirely without foundation, the more so, seeing that under the existing pressure of affairs the Russian telegraph department is quite unable to perform its work. For instance, thousands of telegrams have during the past few months been forwarded by wagon across long sections of Siberia, and the Russian telegraph department seeks to defend itself by transferring the blame to the Northern Telegraph Company.

Carrier Pigeons and Telephones.—The *Daily Telegraph* says that carrier pigeons are to be substituted for the telephone in Berlin during thunderstorms. Some few weeks ago an official in the telephone department was struck by electricity in the discharge of his duties during a severe thunderstorm, and since that incident the authorities have been very careful to close the telephone when a like danger was feared.

Chinese Telegraphs.—The *Times* correspondent at Shanghai telegraphing on August 31st, stated: "Telegraphic communication between Shanghai and Chifu is interrupted owing to a breakdown of the land lines between Tsi-nan-fu and Tsi-ning-chau. The regular cable service will probably begin in the middle of September." A Reuter dispatch on September 2nd, stated that "Communication with Chifu, which had been interrupted for two days, had been restored."

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
South American:—		
Cayenne-Pinheiro	Oct. 11, 1899	
Pará-Maranham	March 1, 1900	
Ceará-Maranham	Feb. 20, 1900	
West Indies:—		
Mo'e St. Nicholas-Cape Haitien	March 6, 1900	
Latakia-Cyprus	June 20, 1899	
St. Louis (Senegal)-Bathurst	Aug. 25, 1900	
Tarifa-Tangier	Jan. 3, 1900	
Landlines:—		
Chinese:—		
Tientsin-Pekin	June 12, 1900	
Pekin-Kalgan	June 14, 1900	
Kalgan-Maimatchin	June 30, 1900	
Tientsin, *viâ* Shanghai	June 16, 1900	
Tientsin-Niuchwang	June 18, 1900	
Shanghai-Chifu	Sept. 1, 1900	Sept. 3, 1900
South American:—		
Communications with all offices of Columbia beyond Buenaventura	January 22, 1900	
Ecuador landlines	March 13, 1897	
Landlines south of Macahé (Brasil)	April 20, 1900	
Landlines south of Serena	July 30, 1900	
Communication "*viâ* Hanekine" interrupted on Persian territory	Feb. 24, 1900	

The German-American Cable.—In a telegram congratulating him upon the speedy execution of the Emden-New York telegraph cable, the German Emperor has appointed Herr Von Podbielski, the Secretary of State, *à la suite* of the Third Regiment of Ziethen Hussars. Telegrams passed between President McKinley and the German Emperor containing mutual congratulations upon the completion of the cable, and expressing the belief that it would contribute to the maintenance of friendly relations between the two countries.

CONTRACTS OPEN AND CLOSED.

OPEN.

Aberdeen.—September 29th. The Electric Lighting Committee wants tenders for two 200-kw. direct coupled continuous current generators, and one 120-kw. balancing set; one 420-kw. direct coupled generating set. All Willans engines. See "Official Notices" August 24th.

Brussels.—September 19th. The Council of St. Jilles, lez Bruxelles, invites tenders for the installation and the commencement of supply upon a part of its territory. Conditions and plan for three francs at the office, No. 14, Parvis St. Jilles, St. Jilles.

Budapest.—October 15th. The Hungarian Minister of Commerce is prepared to receive tenders for the installation of two telephone exchanges, local and interurban, complete in all respects. See "Official Notices" August 3rd.

Copenhagen.—September 19th. Tenders are wanted for two steam boilers for the electricity works. See "Official Notices" August 31st.

Dublin.—October 4th. The Electric Lighting Committee wants tenders for the supply and laying of mains and accessories. See "Official Notices" August 31st.

Dundalk. — September 18th. The Urban District Council invite proposals for a transfer of their electric lighting order for the purpose of supplying electricity for public and private lighting and energy for manufacturing purposes within the urban district of Dundalk. Full particulars at the office of the Borough Surveyor, Town Hall, Dundalk.

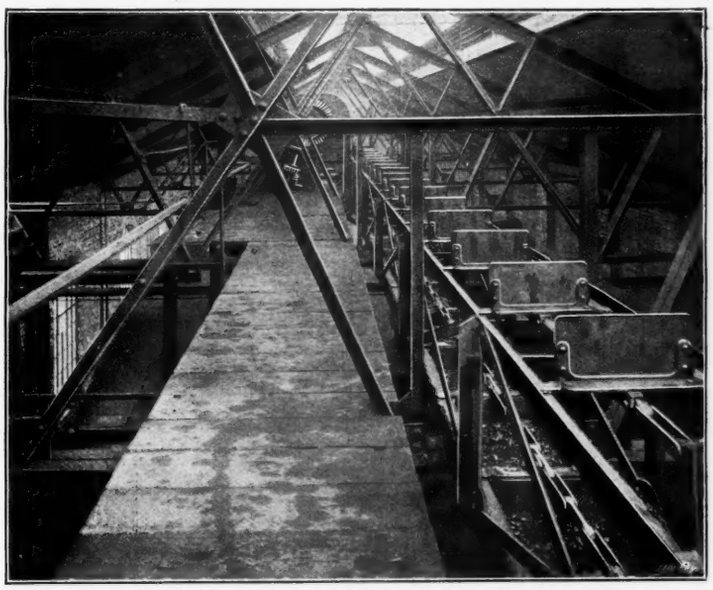
(*Continued on page* 389.)

pose in the new infirmary buildings at the same asylum.

for all emergencies.

THE CITY AND SOUTH LONDON RAILWAY.

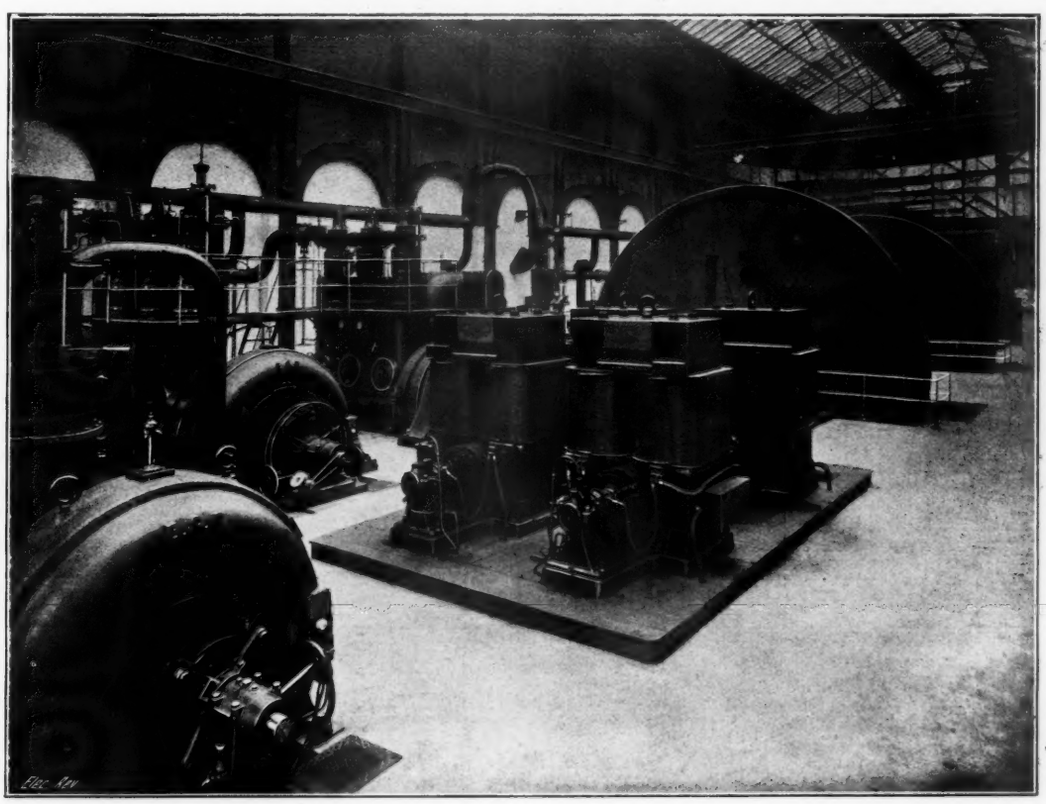
It is ten years, all but a couple of months, since the City and South London Railway was inaugurated by the Prince of Wales, and we suppose no English electrical undertaking constructed either before or since 1890 has received so much attention from home and foreign electrical engineers and railway authorities. There was a time when every American electrical engineer on a visit to this country must see the pioneer underground electric railway, whatever else was left unseen. Designed and constructed under the supervision of the late Mr. Greathead, and electrically equipped under the control of the Doctors Hopkinson, the railway was laid down upon original lines which have, we trow, been of material assistance to the promoters of lines which have been subsequently planned and carried out beneath the city of London.



Coal Conveyor.

The total length of the railway system from 1890 until this year was 3½ miles of twin tunnels, but the two extensions which have been opened this year, as shown on the map which accompanies this article, bring up the length to 4¾ miles.

Of course there have been great developments in electrical machinery for traction work within ten years, and when it became apparent that a new station was required for the purpose of the new sections, it was resolved to adopt plant more efficient and economical than that which was already doing service. The old generating plant, with the exception of a few details, has been sold, and the dismantling process was proceeding at the time of our visit a few weeks ago. The old buildings are now to be utilised for the tool and repair shops required in connection with the railway. A generating station and additional carriage sheds have been erected on a piece of land adjoining the existing station at Stockwell.



General View of Power Station.

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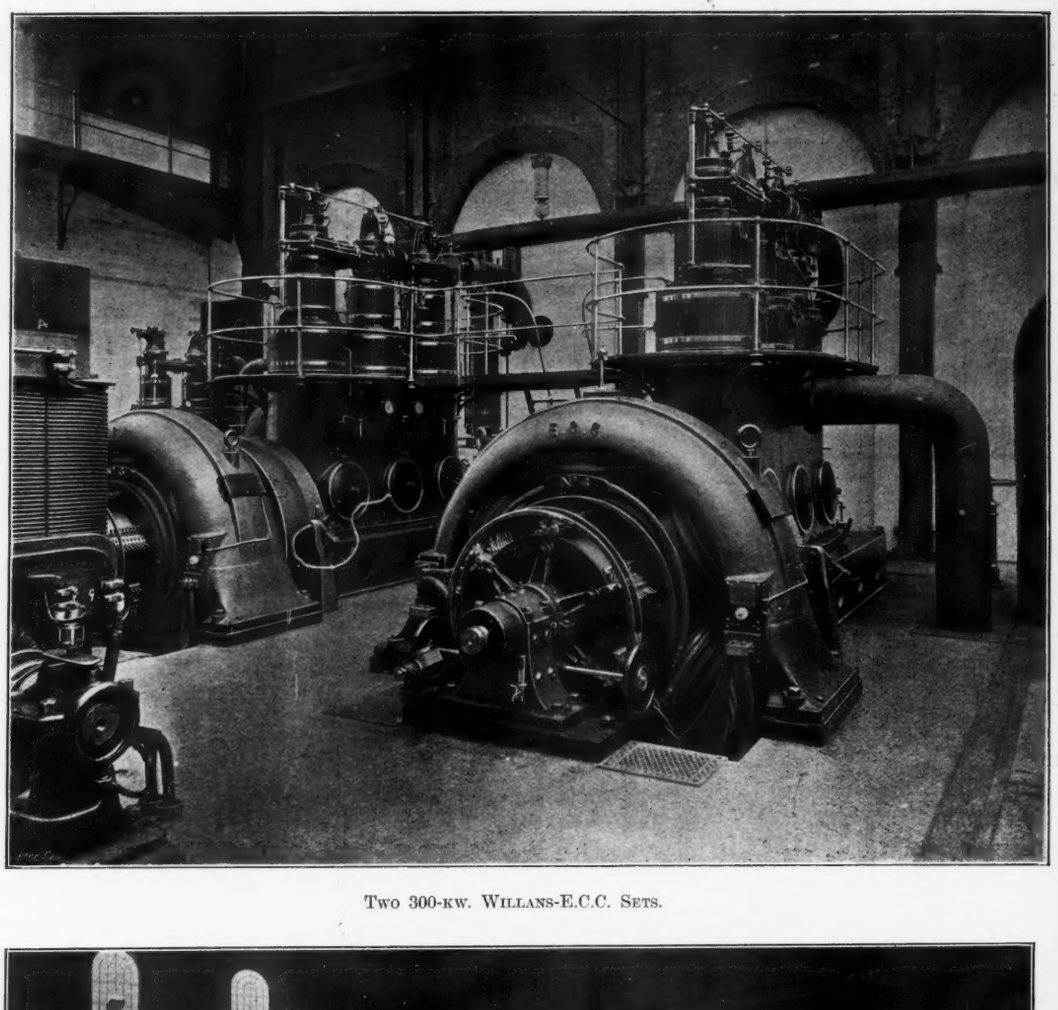
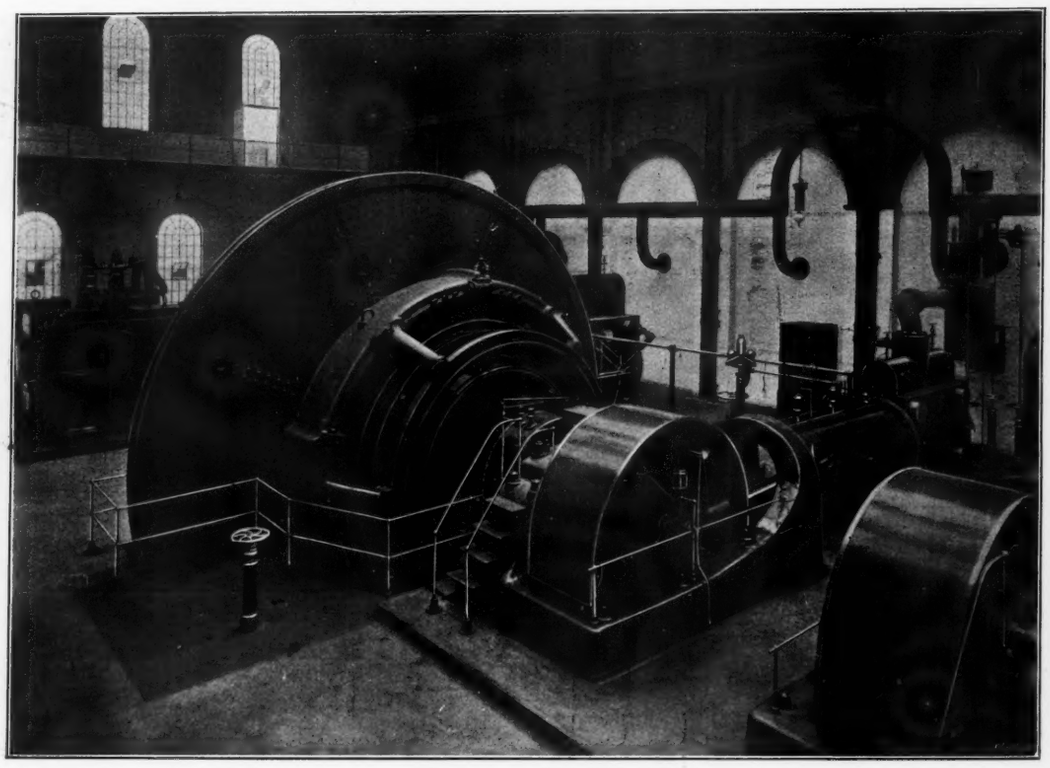


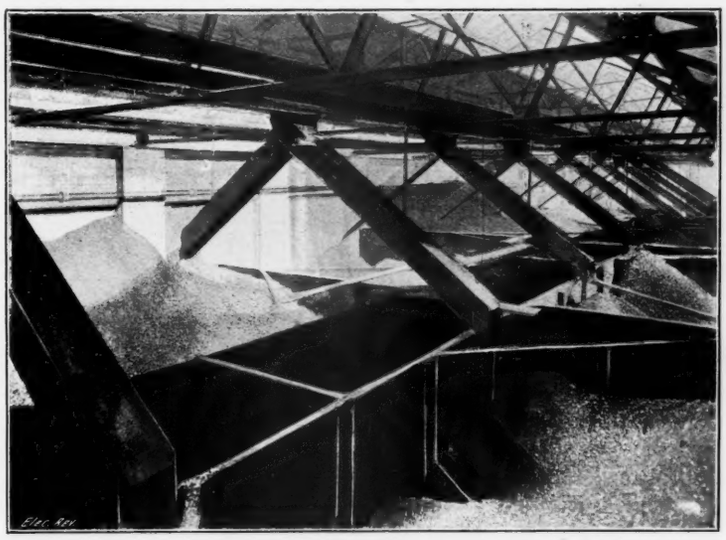
Two 300-kw. Willans-E.C.C. Sets.



800-kw. Cole, Marchent & Morley-E.C.C. Set.

With the extensions to Clapham Common and Moorgate Street, and the further extension to the Angel, at Islington, which was then about to be started, the ordinary two-wire system of working was no longer suitable for the new line, both on account of the drop in the rail return and also the loss in the feeders. All methods were carefully considered, and the possible systems of working were finally brought down to three, namely—

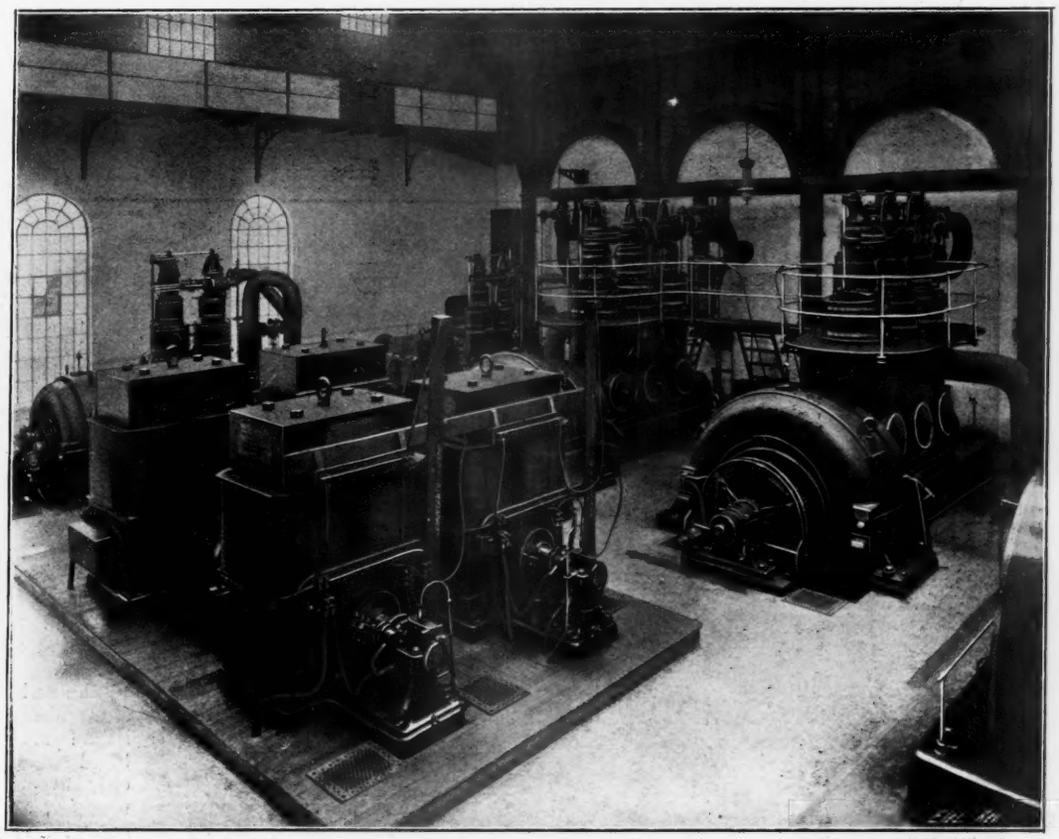
(1) the three-phase system with sub-stations; (2) an extension of the two-wire system with feeder and return boosters; and (3) the three-wire system with balancers. On account of rumours that the latter system was unsuitable for traction work, the question of adopting it was very carefully gone into, and there really seemed no reason why, with proper arrangements for balancing, this system could not be made to fulfil all the conditions required for working the line; and we understand that the experience of the past few months has shown that those responsible for the adoption of the system were justified in their choice.



Coal Bunkers.

The new generating station consists of a steel and brickwork structure with slated roof, capable of being extended to double its present capacity. The general arrangement of the plant is shown on the accompanying plans (p. 387). Special attention is directed to the fact that all the machinery and equipment are of British manufacture. The building as now erected, and containing the plant for the line, including the Moorgate Street and Clapham Common extensions, is 150 feet long by 90 feet wide, the boiler and engine houses being practically under the same roof, and thus the length of the steam piping is reduced to a minimum. Over the boilers the coal is stored on a steel and concrete floor in wrought-iron bunkers with a passage down the centre. These bunkers have a capacity of about 1,000 tons. The coal is delivered by carts to a hopper outside the boiler house, and from here it is elevated and conveyed to the bunkers by an elevating and conveying plant erected by the New Conveyor Company, of Birmingham. We give photographs of the bunkers and the conveying plant. From the bunkers the coal is delivered by measuring shoots to the hoppers of the mechanical stokers below.

The boiler house contains nine Davey-Paxman "Economic" boilers 15 feet 6 inches × 8 feet 9 inches diameter, capable of evaporating 8,000 lbs. of water per hour each, the working pressure being 160 lbs. per square inch. Each boiler, as will be seen from one of our views, is fitted with Vicars' mechanical stokers. The main steam range is duplicated, and consists of lap-welded steel pipes, with all valves controlled from the engine room floor.



Power Station.

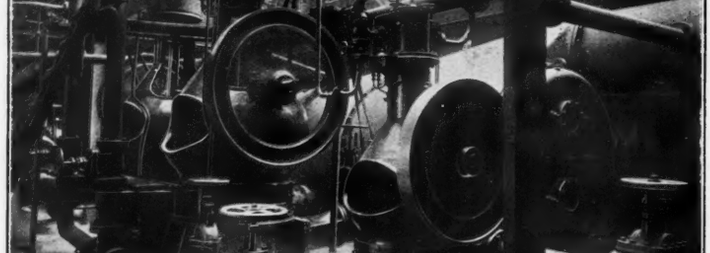
The generators are all direct coupled, and their size

arranged to suit the output at various times of the day, depending upon the number of trains running. With the exception of the original Siemens-Willans set of 125 KW. removed from the old power house, all the generators are of the Electric Construction Company's make, and consist of one 125-KW. generator coupled to a high-speed Willans engine, and two 300-KW. also coupled to Willans engines. The remaining two 800-KW. sets are direct coupled to two Corliss compound engines built by Messrs. Cole, Marchent & Morley. Each of the above sets is capable of taking an overload of 33 per cent. without excessive sparking or heating. All the generators are compound wound to maintain a constant pressure of 500 volts at the switchboard. The shunt regulating resistances are operated from the switchboard platform.

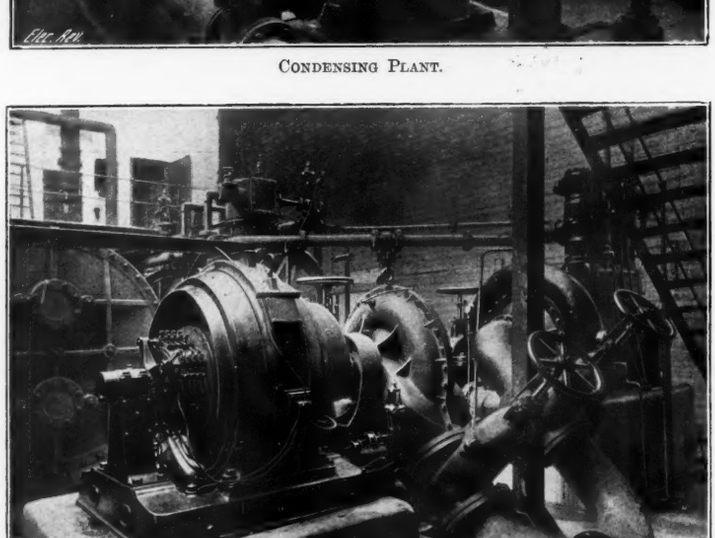
The two Willans engines for the 300-KW. sets are of the patent central-valve compound type of 3-R size. The most economical load of the engine is 470 brake H.P., and the maximum load 585 brake H.P., when running at a speed of 320 revolutions per minute with a steam pressure of 150 lbs.

The engine for the 150-KW. set is of the same type, of 2-I's size. The most economical load of this engine is 180 brake H.P., and the maximum load 220 brake H.P.; the speed is 350 revolutions per minute, and the steam pressure 150 lbs.

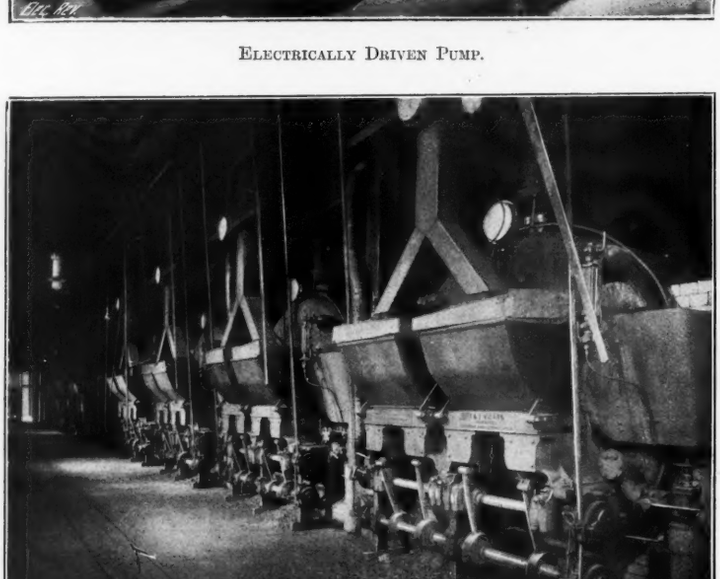
The engines are fitted with very heavy fly-wheels, and extremely good governing is obtained.



CONDENSING PLANT.



ELECTRICALLY DRIVEN PUMP.



"ECONOMIC" BOILERS AND VICARS' STOKERS.

The main engines exhaust into a 32-inch diameter main running the entire length of the engine house, to one end of which is coupled a surface condensing plant by Messrs. Cole, Marchent & Morley, shown in our photographs. The air-pumps are of the Edwards type. The cooling water is passed over two Klein's cooling towers, which we illustrate, by two centrifugal pumps, one steam driven and the other driven by an E.C.C. motor of 60 B.H.P. The other end of the exhaust main rises above the building, and has an automatic valve which opens when a small pressure rises in the main.

The distribution is carried out on the three-wire system, with the running rails as the middle wire and the working conductor in each tunnel as the outers, with a difference of potential of 1,000 volts between, *i.e.*, 500 volts between the working conductor and the running rail in each tunnel. The working conductor in each tunnel is fed at three points, viz., Stockwell, Kennington, and London Bridge. The Kennington feeder is coupled through a booster to compensate for the drop in the feeder, and at London Bridge the battery sub-station and reducers maintain a constant pressure.

The sub-station at London Bridge is fed from the main board at Stockwell on a five-wire system, *i.e.*, a motor-generator is placed between the bus bar and the high tension feeder, adding 500 volts to the feeder. The high tension board shown on the right

of the main board is connected with the sub-station board by Callender's armoured cables, where the voltage is reduced to 500 volts per side by reducers on the Electric Construction Company's patent high tension continuous current system. In addition to the reducers, the sub-station contains, in three arches, a battery of 556 No. 49 H.B. 11 type Tudor accumulators of the following capacity :—

450 amp.-hours when discharging at 150 amperes for 3 hours
350 amp.-hours when discharging at 350 amperes for 1 hour

with the necessary charging transformers. The motor-generators, transformers, and switchboard are shown in our two photos of this sub-station.

At Moorgate Street, the Elephant and Castle, and Clapham Common stations balancers are placed, each machine being capable of dealing with a load of 160 to 200 amperes concentrated on one side of the system.

On the Moorgate Street and Clapham Common extensions the lifts are worked electrically from the same source of supply as the locomotives.

The contract for the complete electrical equipment was let to the Electric Construction Company, who were ably represented on the work by Mr. N. H. White, with Messrs. Willans & Robinson, Messrs. Cole, Marchent & Morley, the Tudor Accumulator Company, and Callender's Cable Company as sub-contractors.

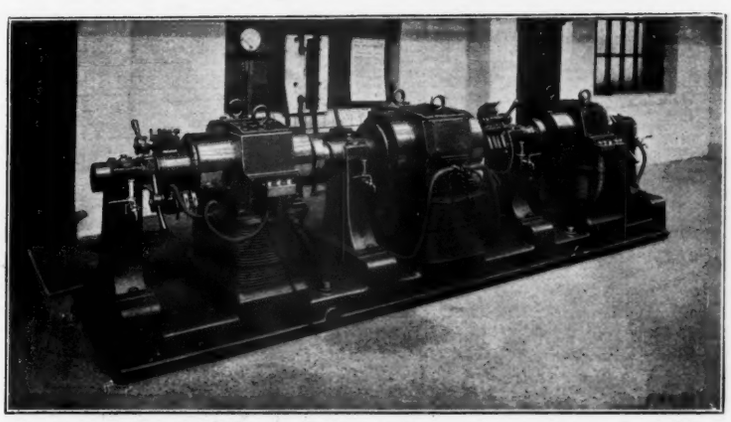
Messrs. Cole, Marchent & Morley were entrusted with the erection of the condensing plant, water coolers, steam and exhaust pipes.

The boilers, feed pumps, stokers, and all pipe work connected therewith, were erected by Messrs. Davey, Paxman & Co.

The New Conveyor Company, of Birmingham, erected the coal handling plant, and as this was erected to the ideas of Mr. P. V. McMahon, the company's engineer, some special notes regarding it may be here given.

Switchboard. (Left hand.)

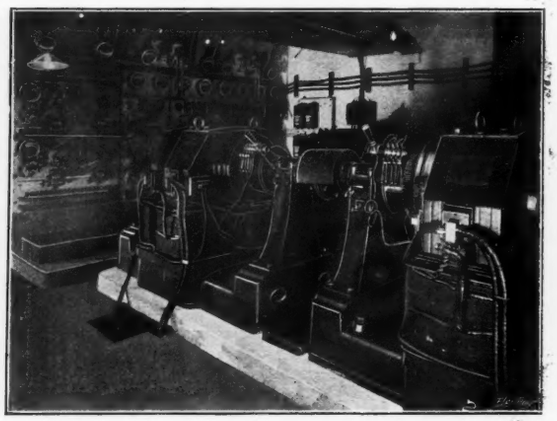
Switchboard. (Right hand.)



Boosting Set.

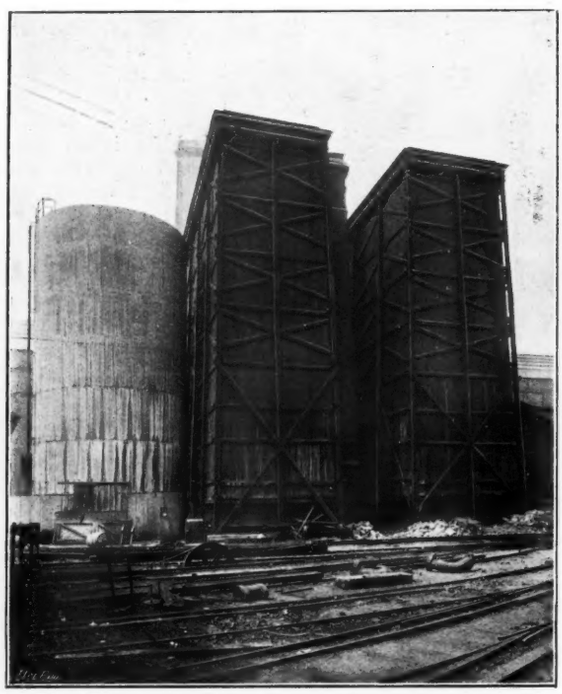
The coal is tipped into a concrete hopper which will hold about 25 tons, and is situated over the elevator boot-shield, with a plate to direct the coal into the buckets, and prevent it falling into the spaces left round the elevator, and to allow a man to get down to the foot of same and inspect the gear. The elevator has 12 inches seamless stamped steel buckets, spaced 2 feet apart on the No. 5 standard wide wearing surface coal elevator chain, and skidder bars 4 inches × ⅜-inch flat iron are fitted on so as to slide on the angle iron guides carrying the upgoing load and the empty return strand of chain and buckets. These angle irons are fitted inside a steel case made of $\frac{3}{16}$ inch plate, which renders the elevator dust-tight. The distance between the centres of the top and bottom shafts is 56 feet, and the shafts are 3 inches diameter, being carried at the top by brass bushed split pedestals bolted on angle irons attached to the outside of the elevator case. Lower down on this case additional angles are rivetted to carry two pedestals, in which a countershaft, fitted with reducing gear, is fixed, and at the opposite end of the shaft a bevel wheel is fixed to gear with one on the diagonal shaft carried some distance down the elevator and driven by a lower countershaft, which passes through the elevator to the cross-shaft geared at the opposite end with the main shaft, which is driven by a 15 B.H.P. Westinghouse electric motor. In the boot of the elevator there is fixed a patent automatic feeder,

which allows only sufficient quantity of coal to pass into the boot to be comfortably picked up by the buckets. The coal after being lifted is tipped over the top sprockets



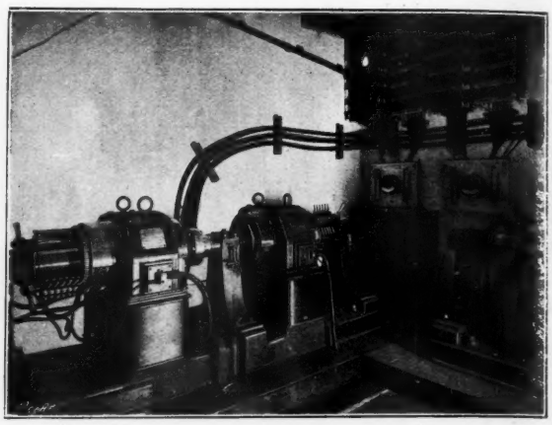
London Bridge Sub-station.

down a shoot into the conveyer. This is made on Little's patent push plate design, 134 feet centres, and consists of a steel trough, the frame of $\frac{3}{8}$ inch bottom plate, to which two 6-inch × 3-inch channel irons are rivetted with angle iron uprights about 3 feet high, fixed by means of cleats to the frame, and at the top of these are rivetted angle irons which carry the return chain and scrapers. Both the top and bottom guides on the elevator and conveyer are lined with hard strips. The chain is made from stamped steel with alternate solid single and double links of 6-inch pitch, the solid single link is 1 inch wide by $1\frac{1}{2}$ inches deep, and the double links are $\frac{3}{8}$ inch wide and $1\frac{1}{2}$ inches deep and secured to the single links by means of hardened steel pins



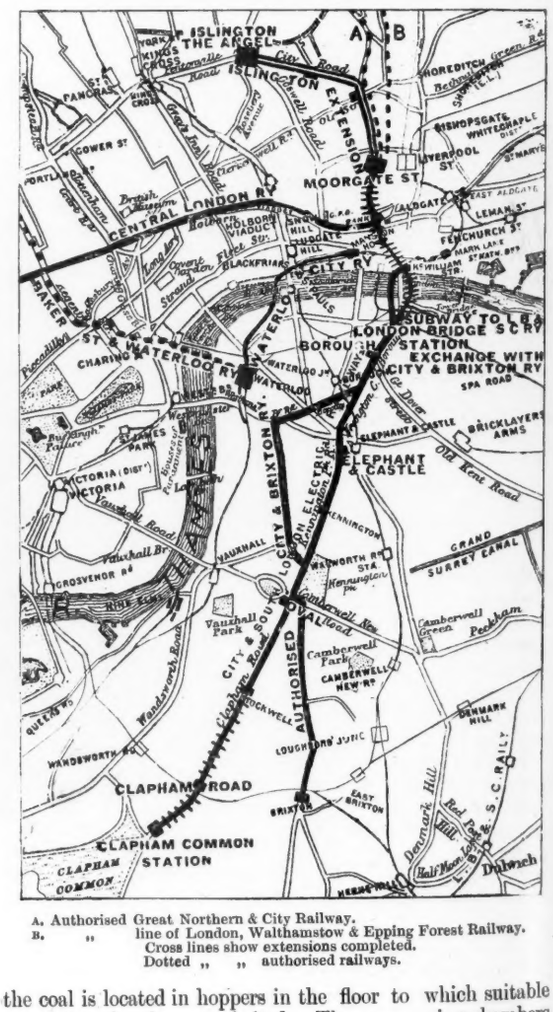
Cooling Towers.

$\frac{3}{4}$ inch diameter; the wearing part is turned down at ends to $\frac{5}{8}$ inch, so that the double links are securely rivetted to the pin, allowing same to turn only in the wide single link. The push plates fixed at 2 feet pitch are detachable, and are themselves formed to allow of the wearing parts being renewed without detaching the body from the chain; thus the bar which slides on the guides, is fixed by three bolts, and the scraper can be removed by taking out five small rivets, and any of these repaired pieces can be obtained or fixed at the depôt. The



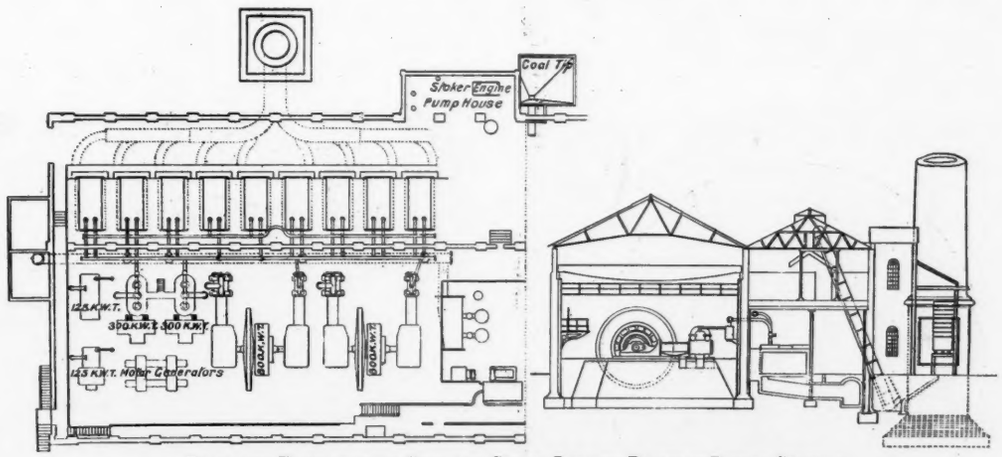
London Bridge Sub-station.

conveyer has 20 outlets with sliding doors under which are fixed two-way shoots delivering to either side into the coal bunkers. The bunkers are 120 feet long by 19 feet and 12 feet wide respectively by 8 feet deep, made of $\frac{1}{4}$-inch plate, and stiffened with angle irons, &c. These bunkers are divided so as to prevent spreading of fire which might occur in the coal bunkers. Outlets with vertical balanced sliding doors worked by chain pulleys and weights are fixed on the plates which form a passage between the two bunkers, and

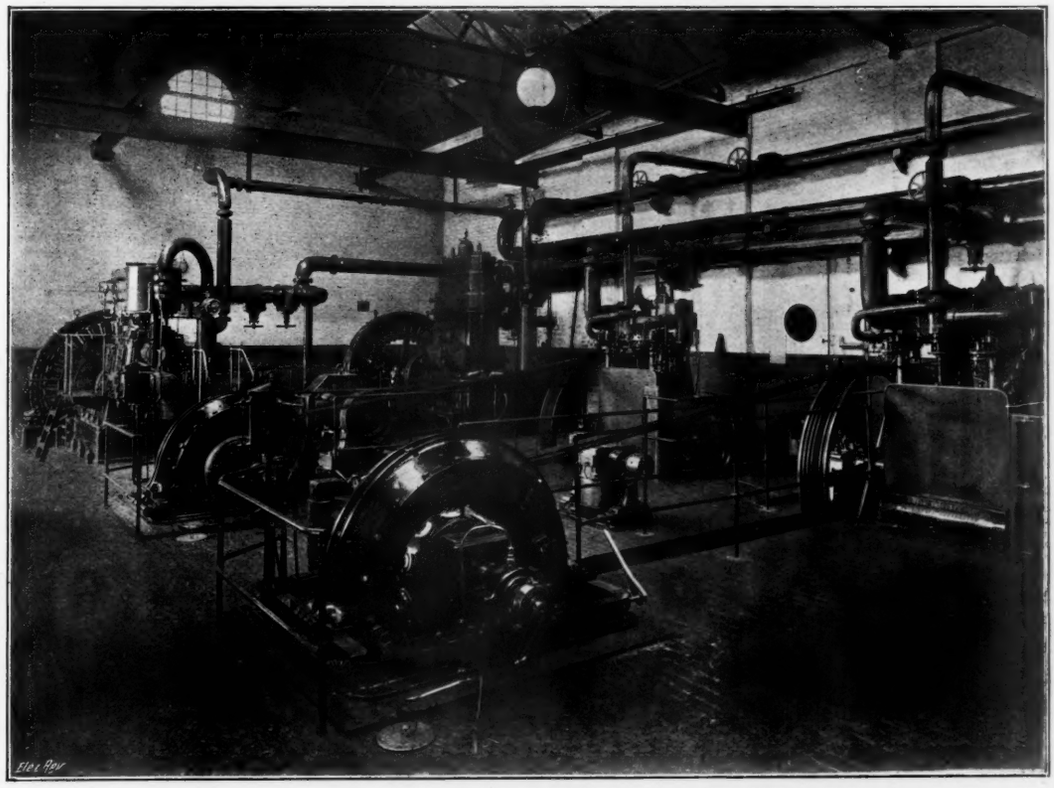


A. Authorised Great Northern & City Railway.
B. " line of London, Walthamstow & Epping Forest Railway.
Cross lines show extensions completed.
Dotted " " authorised railways.

the coal is located in hoppers in the floor to which suitable measuring chambers are bolted. These measuring chambers have a capacity of 2 cwts. each, and are 10 in number, each



Plan and Elevation of City and South London Railway Power Station



Prescot Electricity Works.—General View of Engine Room.

one supplying the two hoppers on one boiler ; they are fitted with top and bottom sliding doors worked by a lever at the charging floor level to open and close the two doors at the same time, and a pointer revolving on a dial registers the number of charges put into each boiler. The ash plant consists of an 8-inch bucket elevator fitted with strong seamless buckets attached to 4-inch pitch 3½ inches wide malleable cast-steel chain. The elevator is entirely cased in and receives the ashes through a strong grating fixed on the inside of the boiler house, and the ashes gravitate to the boot down a small shoot. The ash is dumped over top sprockets into a bunker having a capacity of 12 cubic feet made in ¼-inch plate with necessary angle iron stiffening, &c., and fitted with a door worked by a lever and connecting rod from the floor level, and carts drawn under this hopper receive the contents through the door. The structure supporting the ash plate consists of 6 inches × 3 inches channel iron uprights, 8 inches × 4 inches cross stays, and the necessary amount of angle and flat bar bracing.

The engine and boiler houses were built by Messrs. Whitehead & Co., and the chimney and flues by Messrs. W. Neil & Co.

The whole of the work was carried out under the super-

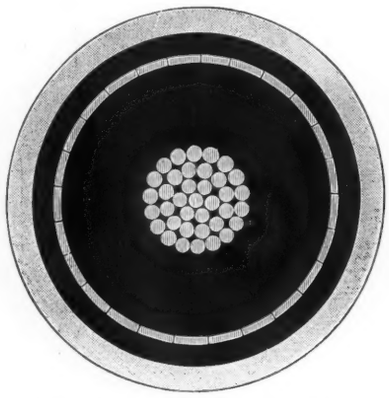
British Insulated Wire Company's Works.—Brass Shop.

body from the chain; thus the bar which slides on the

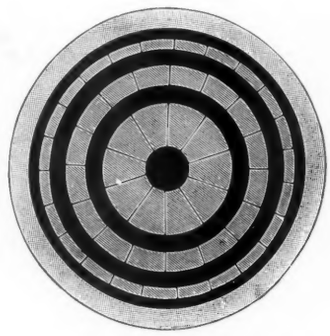
have a capacity of 2 cwts. each, and are 10 in number,

vision of Mr. P. V. McMahon, the company's engineer, to whom we owe our thanks for his assistance in the preparation of this article. Mr. McMahon also acted as consulting engineer for the work, assisted by Mr. N. Rheam, the company's chief assistant engineer.

Clapham and Moorgate Street will no doubt help on the way to commercial success, but the Islington extension, which will be completed next year, is the one from which the greatest things are expected. The intention of the company is not to stand still, however, for extensions farther

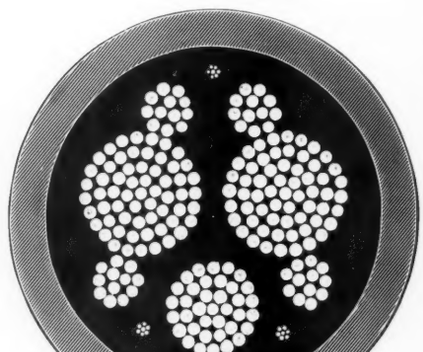


10,000-volt cable for Deptford & Willesden.

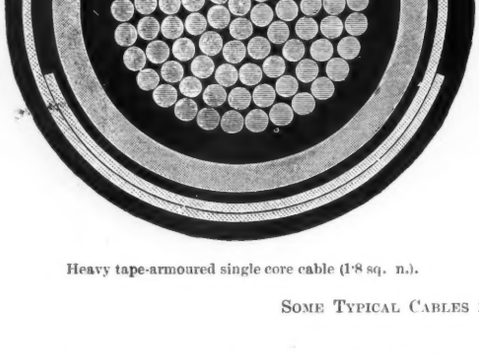


Hollow core segmental cable for A.C. distribution

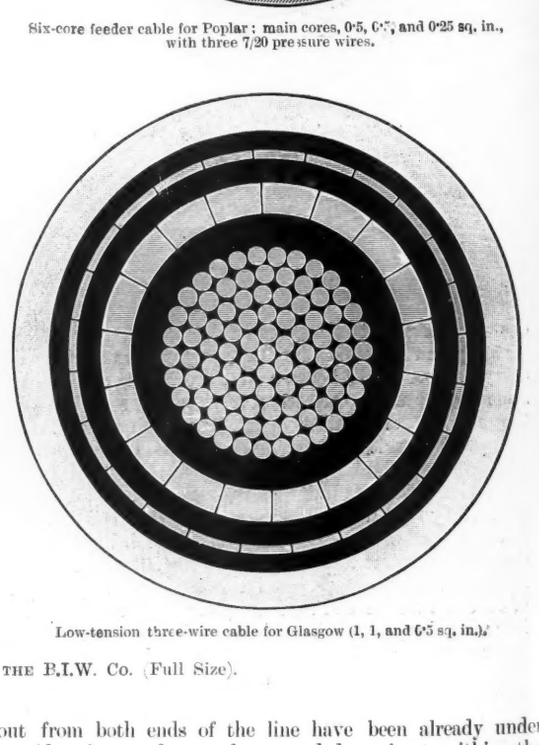
"Clover Leaf" three-core wire-armoured cable.



Six-core feeder cable for Poplar; main cores, 0·5, 0·[illegible], and 0·25 sq. in., with three 7/20 pressure wires.



Heavy tape-armoured single core cable (1·8 sq. n.).



Low-tension three-wire cable for Glasgow (1, 1, and 0·5 sq. in.).

Some Typical Cables made by the P.I.W. Co. (Full Size).

The City and South London Railway has had an uphill fight ever since its birth, and no one could wish it success more sincerely than those who have followed the troubles against which it has had to contend. The extensions to

out from both ends of the line have been already under consideration, and may be regarded at least within the sphere of the probable. When the company requires to issue new capital for further sections we do not anticipate

that it will have to concern itself much as to whether investors will be ready with the money, for underground electric railways are very much in favour with most people.

THE BRITISH INSULATED WIRE COMPANY'S WORKS AT PRESCOT.

(*Concluded from page* 347.)

The operations of the company are not confined to cable making; joint boxes and other accessories, including fuses and switch gear for their equipment, are turned out in large quantities. For the manufacture of the latter there is a brass and copper foundry, and a well-equipped machine shop, of which we give a view. Besides lathes, shaping machines, band saws, &c., there is a large lathe for turning rolls, &c., and a number of automatic screw-making machines. Piles of disconnecting boxes are seen in the foreground of the view, as well as the switch gear for a tramway feeder pillar. A new machine shop, three times as large as the present one, is about to be erected for the manufacture of insulators and accessories for the overhead equipment of trolley lines; when this is complete the company will be in a position to supply everything required for line equipment, from the trolley wire to the terminals at the power station.

A repair shop and smithy provide for the maintenance of the cable machinery, and all the tools used in the works are made in a separate department.

The older portion of the works is driven by two horizontal Corliss engines, but most of the power is supplied from a dynamo room adjoining. The latter will shortly be superseded by a power supply from the adjacent Prescot electricity works.

Not the least important part of the factory is the copper store, in which a floating stock of copper worth about £50,000 is constantly on hand. A suite of offices, most comfortably furnished, occupies the front of the buildings, and provides accommodation for the engineer and manager, Mr. Nisbett; the works manager, Mr. Bates; the secretary, Mr. E. Tracey; the board of directors, and the staff of clerks, draughtsmen, &c.

The guiding principle upon which the works are run is that of utilising labour-saving machinery *for all that it is worth;* that is, the machines are worked at the highest possible speed and load, in recognition of the truth that it is far better to wear out machines and replace them than to muddle along with old apparatus. For the same reason no hesitation is felt in scrapping plant wholesale directly improved methods or machines are available. We may put it that the load factor, not only of the plant but also of the staff and buildings, is kept as high as possible.

Among recent contracts carried out by the company may be mentioned the high tension cables for the Willesden and Deptford transmission lines, each having two cores of ¼ square inch section with insulation ½ inch thick, working at 10,000 volts pressure alternating; and the big Glasgow cable, the largest ever made, having triple concentric cores of 1 square inch, 1 square inch, and ·5 square inch cross section. The last-mentioned cable was 3⅛ inches in diameter over the lead sheathing. All the new cable for the City Electric Lighting Company is also being made by the B.I.W. Company. The largest single-core cable manufactured by the company had a copper cross-section of 1·8 square inches.

We give on the opposite page some cross-sections of these and other cables.

We must not omit to express our thanks to Mr. Nisbett, who furnished us with the data for this article, and Mr. Bates, who piloted us through the various departments, on the occasion of our recent visit to the works.

Prescot Electricity Works.

One of our views on p. 387 shows the engine room of the above works, which were erected by the British Insulated Wire Company for the lighting of Prescot and the neighbouring townships, some of them three miles away. This station contains two Ferranti alternators and a Mordey machine, rope driven by Browett-Lindley vertical engines. Two large Johnson & Phillips alternators, of a later date, are visible in the background; these are direct coupled to engines of the same type as the smaller ones. A new direct current set, which will be used chiefly for the supply of power to the factory, is about to be erected, consisting of a Browett-Lindley engine and a 400-kw. dynamo of the English Electric Manufacturing Company's make.

There are two 30 feet × 7 feet Lancashire boilers in use, and two more, 30 feet × 8 feet, with Vicars' stokers and Musgrave superheaters, are in course of erection. A Green's economiser is provided, and a condensing set by Messrs. Browett, Lindley & Co. The feed pumps are of the Weir type, together with one by Worthington.

Feed and condensing water are obtained from a large reservoir close by, belonging to the factory; this is replenished from a disused and flooded coal pit about a mile away, where a motor-driven centrifugal pump has been put down.

The output of the works last year was about a quarter of a million units, which will be largely exceeded when the power plant is inaugurated; the load factor is already very high, thanks to the long hours of the B.I.W. works.

We are indebted to the resident engineer, Mr. Sprunt, for the above particulars, and for his kind assistance on the occasion of our visit.

CONTRACTS OPEN AND CLOSED.

(*Continued from page* 380.)

Eastbourne.—October 4th. The Corporation wants tenders for a water-tube boiler and fittings, 400-kw. steam alternator and switchboard. See "Official Notices" to-day.

Germany.—September 10th. The Hamburg Finance Deputation is inviting tenders for the supply and erection of two 30-ton electric cranes. Particulars may be obtained for 3s. from the Secretariat II. der Finanz Deputation (Rathhaus Ober-Erdgeschoss, Zimmer 429), and tenders marked 339 are to be sent to Die Finanz Deputation, Hamburg.

Glasgow.—September 28th. The Corporation are prepared to receive tenders for the supply and fitting up of the power station piping required at Pinkston. Specifications, &c., on application to Mr. John Young, general manager, 88, Renfield Street, Glasgow. A bank draft for five guineas, payable to the General Manager, must accompany each application for specifications.

Greenock.—September 10th. The Police Board requires tenders for water-tube boilers, steam dynamos, boosters, switchboard, piping, &c., for electric traction. See "Official Notices" August 24th.

Hackney.—September 12th. The Electric Lighting Committee is wanting tenders for the supply of condensing plant, cooling apparatus, pipe work and valves, feed pumps, switchboard and boosters, arc lamps, meters, crane and workshop equipment. See "Official Notices" August 17th.

Hammersmith.—September 12th. The Vestry wants tenders for two single-phase alternate current motors coupled to two centrifugal pumps. See "Official Notices" August 24th.

Hampstead. — September 27th. The Vestry invites tenders for eight marine boilers, piping, feed-heater or detartariser, fuel economiser, and tanks. See "Official Notices" August 24th.

Hull.—September 27th. The Corporation wants tenders for certain steam and water pipes, pump, water softener, &c., for electricity works. See "Official Notes" August 24th.

London.—September 24th. The L.C.C. is inviting tenders for the supply of mains for the installation for the Victoria Embankment and Westminster Bridge. See "Official Notices" August 31st.

London County Council.—September 22nd. Tenders are wanted for boilers, engines, dynamos, &c., at the Horton Estate, Epsom, Surrey. See "Official Notices" August 10th.

Luton.—September 14th. The Town Council invites tenders for watt-hour and demand meters. See "Official Notices" August 3rd.

Manchester.—September 18th. The Tramways Committee wants tenders for two steel boilers for heating, cast-iron pipes, rubber rings, bolts and nuts, steel stanchions, and 100 car trucks. See "Official Notices" to-day.

Mexborough.—September 15th. The Council wants tenders for a Lancashire boiler, two 50-kw. dynamos, balancer and boosters, feed heater, and pump, switchboard, battery, mains, crane, and adapting the street gas lamps for electric lighting. See "Official Notices" August 31st.

Nelson.—September 8th. The Corporation wants tenders for a 200-kw. steam dynamo. Specifications from Mr. Allen, engineer at the gas works. £2 2s. deposit.

Nelson.—September 18th. The Gas and Electricity Committee wants tenders for the supply of electric light cable. See "Official Notices" this week.

Perth. — September 15th. The Commissioners want tenders for direct current meters and cut-outs. See "Official Notices" August 31st.

Plumstead.—September 19th. The Vestry wants tenders for boilers, refuse destructor, steam fittings, economiser; steam piping, pumps, &c., &c.; steam generators—two 300-I.H.P.; two 150-I.H.P.; and one 100-I.H.P.; condensing plant, cooling tower, &c.; switchboard; battery; traveller; mains, meters, arc lamps and posts, &c. See "Official Notices" August 10th.

Portsmouth.—September 10th. Tenders are wanted for electric light fitting work at the new Drill Hall. See "Official Notices" August 31st.

Preston.—September 10th. The Guardians want tenders for an electric light installation at Fullwood Workhouse. See "Official Notices" August 24th.

Salford.—October 2nd. The Cleansing Committee of the Corporation wants tenders for a two or three-cell refuse destructor. Also for a six-cell destructor on the forced or accelerated draught principle, together with necessary boilers, &c. See two "Official Notices" August 31st.

Southampton.—September 10th. The Harbour Board wants tenders for a 30-cwt. portable electric crane. Specification from Mr. Bowyer, Harbour Offices, Town Key. Deposit £5.

Southampton.— September 11th. The Guardians want an electric lighting plant erected at the new workhouse infirmary, Shirley Warren. Particulars from Mr. J. Aldridge, 9, Victoria Street, S.W.

Sunderland.—September 21st. The Corporation wants tenders for triple expansion high speed, direct current dynamos, Lancashire boilers, feed pumps. See "Official Notices" August 31st.

Walthamstow. — September 25th. The Council is inviting tenders for gas plant, gas engines, dynamos, switchboards, boosters, balancer, and measuring instruments. See "Official Notices" August 31st.

Wrexham.—Tenders are wanted for a dynamo and three electric motors, &c., to drive centrifugal pumps. See our advertisement pages August 31st.

CLOSED.

Accrington.—The Corporation has given the contract for wiring the electricity works to Maund & Leed, of Southport, £245.

Blackpool.—The contract for the supply of a storage battery, required by the Corporation for the extension of their tramway system, has been placed in the hands of the Hart-Accumulator Company, Limited.

France.—The French Post and Telegraph authorities have just given out contracts for a large quantity of bronze telegraph wire as follows:—Les Etablissements Mouchel, of Paris, 60 tons at 2,947½ francs per ton; M. Grammont, of Port de Cheruz, 30 tons at 2,949½ francs; Messrs. Lazare Weiler & Co., of Paris, 30 tons at 2,945 francs; La Compagnie Française des Métaux, of Paris, 30 tons at 2,947½ francs.

Glasgow.—Yesterday afternoon contracts amounting to £45,000 were to be let by the Corporation for the preparation of section No. 4 of the electric lines.

Mersey.—The Docks and Harbour Board have accepted the tender of Messrs. Foote & Milne, for an electric light installation for the Stanley Dock Warehouses.

Salford. — On Wednesday the Corporation resolved to approve of a contract to be entered into with Messrs. W. T. Glover & Co., Limited, for supplying, delivering, and laying the lighting cables, tramway feeders, and street lighting accessories for the sum of £159,648 12s. 8d.

Torquay.—The Town Council has accepted the following tenders for additional plant at the electric light works: — Two water-tube boilers and superheaters, without brickwork, Babcock and Wilcox. £1,380; one 250-kw., and one 40-kw. steam alternator, Rosling & Appleby, £3,655; pipework, condenser, tank, &c., Babcock & Wilcox, £2,653; extension of switchboard, Ferranti, Limited, £220; two watt-hour meters and one voltmeter, the General Electric Company, £60; foundation and schedule prices, S. Blatchford, £144; four transformers, the British Electric Transformer Company, £258.

REVIEW.

The Law and Practice Relating to Letters Patent for Inventions. By Roger William Wallace, Q.C., of the Middle Temple, one of Her Majesty's Counsel, and J. Bruce Williamson, Esq., of the Middle Temple and North Eastern Circuit, Barrrister-at-law: Royal 8vo., pp. 922. London: William Clowes & Sons, Fleet Street.

A new treatise on the law of patents always attracts a certain amount of attention both in legal and commercial circles. The handsome volume which we now have the pleasure to review, is bound to meet with something more than the ordinary share of welcome from those into whose chambers or offices it will be introduced. The work of Messrs. Wallace & Williamson is worthy of notice, not only because of its size, but because of the importance which all competent judges will attach to every word which flows from the pens of its two learned authors—the senior of whom has long been known to fame in important patent cases—while the junior, in addition to other qualifications, has already made his mark as a writer of legal text-books.

Seeing that this stupendous work must be the result of many years of anxious thought on the part of its authors, it behoves a reviewer to exercise more than ordinary care in making any criticism upon it. Before expressing an opinion, it may be as well to describe as shortly as possible the scope and object of the work.

Everything relating to the law of letters patent seems to have been dealt with by the authors, whose labour has produced a veritable encyclopœdia. From the circular which is issued by the Patent Office, as a kind of guide to the would-be proprietor of a patent, to the most abstract principles of patent law, nothing appears to be omitted. This is a characteristic which is likely to render the book valuable alike to the lawyer, the patent agent, and the layman. But it is to the lawyer that the book is offered, and it must, therefore, be judged from a lawyer's standpoint.

The main sub-divisions are as follows:—About 600 pages are devoted to the law and practice relating to letters patent as derived from an exhaustive study of the statutes and rules and the cases decided thereunder. There then follow four appendices. Appendix I. contains all the important statutes; Appendix II., the statutory and other rules relating to letters patent; Appendix III. comprises the text of the international convention relating to the protection of industrial property, and the Patent Office circular of information; and last, but not least, Appendix IV. contains a most valuable collection of forms and precedents of the various legal documents made use of in connection with patents.

The first chapter contains a short history of the patent law, and we think the authors have exercised a wise discretion in making that history as short as possible. History is out of place in a legal text-book, save in so far as it tends to explain the archaic language used in many of the older statutes. The effect of this chapter is well summed up on page 13, where it is stated that "the stream of English patent law still flows direct from the fountain of the Royal prerogative, but along the defined course determined centuries ago by the common law."

The next chapter contains the terms and effect of the grant of letters patent. With regard to the third chapter, which deals with the question—"Who may be the grantee of letters patent?" we are glad to find that the authors have gone into this question with elaborate care. The patentee of a complicated invention must often be assisted by others in order to complete his designs; the master is frequently indebted to his servant for valuable suggestions when putting an idea into practice. The exact rights and liabilities of the parties in these cases are clearly defined by the authors.

The next two chapters are devoted to the subject matter of the grant and the various elements which must combine to make an article good subject matter for a patent. These chapters, taken with Chapter IX., are a complete answer to the question, What is a new manufacture within the meaning of the statute of monopolies? Two chapters on "Anticipation" are inserted between those which deal with "Novelty" and "Utility." As a matter of arrangement it

New Form of Electric Automobile.—This automobile (for the illustration of which we are indebted to the

the Crystal Palace Electric Supply Company. Mr. Phillips

might have been more artistic to postpone the question of anticipation until every necessary attribute of a valid subject matter had been discussed.

Chapters X.—XIII. deal with the specifications. Here we find the object of the specification, the rules which guide the Court in determining its construction, valuable information as to the disastrous results which ensue from drawing the claim too wide, and the procedure which must be adopted by the patentee if he wishes to amend his specification. Chapters XIV. and XV. are devoted to procedure on applications for and oppositions to letters patent, affording a valuable guide to the patent agent, to whom these operations are so often entrusted. The next two chapters are devoted to assignments and licenses, while the subject of compulsory licenses, to which an entire book was recently devoted by Mr. J. W. Gordon, is disposed of in a single chapter! Not that we find any fault with this; on the contrary, we think the subject is of somewhat overrated importance, inasmuch as the enormous cost of the proceeding for a compulsory licence has practically rendered Section 22 of the Patents Act, 1888, a dead letter. Chapter XX. is devoted to the extension of the patent term, and in common with other parts of the work, it seems to include every decision of importance relating to the subject in hand.

Of all the chapters the most complete, and, as we think, the most important to the legal practitioner, is that which deals with an action for infringement. The necessity for every step and the means whereby every necessary step in such an action may be taken are carefully pointed out, from the service of a writ to the procedure on appeal to the House of Lords. Particularly instructive are the pages devoted to the remedy which may be obtained by action for infringement and the important question as to the measure of damages. And here we notice the extraordinary case of Gavioli *v.* Shepherd, 1900, 17 R.P.C. 157, duly referred to. It was there decided that when an action is brought for infringement for making machines similar to those of the plaintiffs, and the defendant is able to prove that he never could have afforded to buy the plaintiff's machine, the plaintiff cannot recover damages. Chapters XXIII. and XXIV. are devoted to actions for threats and for revocation of patents; Chapter XXV. to offences under the Patents Acts; while a chapter on international protection of inventions completes the textual portion of the book.

A captious critic might assert that the number of pages in this portion of the work could have been materially shortened, had the authors refrained from quoting the judgments of the courts at such great length, and contented themselves with laying down the principle involved in each case. Upon the whole, however, and bearing in mind the source whence cases on the law of patents are derived, we think they were wise in referring to "the book at large." A work of this kind, which is stocked with liberal quotations from the judgments in all important patent cases, ought to enable the practitioner to dispense in some measure with the use of the Patent Office Reports. We feel sure that all practitioners would gladly avail themselves of anything as a substitute for those dreary publications. Although "official" (or perhaps because they are "official"), these are among the worst reports which ever find their way into a lawyer's library. Doubtless the highly technical nature of many modern patent cases involves a lengthy inquiry, and the consideration of much expert evidence; but we see no reason why, in the hands of a reporter, the shorthand note of a patent case should not be boiled down to some extent instead of being set out at almost full length. When we remember that for the compilation of their monumental work, our authors have had to wade through this enormous mass of undigested matter, our tribute to their undaunted courage and perseverance becomes great indeed.

We have already hinted that one of the most valuable portions of this book is Appendix IV., which contains a "precedent" of every conceivable form of writ, pleading, petition, caveat, certificate, order, &c., which may be used in any legal proceedings connected with a patented invention, not to mention a copy of a "complete specification" in the authorised form, together with a drawing in the Patent Office style. Such forms are of incalculable value to a lawyer who has not specially devoted himself to patent cases, and who is often at a loss for a precedent. Most of the precedents in the work under review have never before appeared in print, while all of them appear to have been taken from cases which have actually arisen. In addition to what we may term practice precedents, there are many examples of assignments, licenses, and compulsory licenses which cannot fail to act as useful guides to all who traffic in letters patent, and who want to know the significance of the various clauses in their title deeds.

Two other features of prime importance in every law book remain to be considered. We refer to the table of cases and the index. The table of cases leaves nothing to be desired. It contains a reference to every patent case, and to all the reports where a note of the case is to be found. In addition to this, a word or two is added in brackets which sufficiently indicates the matter in dispute, so as to enable anyone who is in search of an authority upon a particular point to see at a glance whether the case referred to is pertinent to the question. This is a feature which might advantageously be copied in other law books.

The index, which plays an important part in this as in every other work of reference, appears to have been carefully compiled, and to cover all the ground traversed in the text. The necessity for a very full index in this particular volume is great, for the absence of side-notes, and the comparatively long intervals between the sub-headings throughout the text, is likely to render a search for the law upon some particular point rather laborious unless that search is aided by a reference in the index to every page where the point in question is treated of. We have no doubt, however, that when put to the test in actual practice the index will perform what is required of it, especially as we find that the authors have had the assistance of a third party in its compilation.

The type and general style of the work are beyond all praise.

In conclusion, this book, which has stamped upon its cover the Armorial Bearings in use at the Patent Office, is well worthy of the honour so conferred. It bids fair to take a leading place among legal text-books dealing with the law of patents, and will remain a lasting monument to the industry and ability of its authors.

NOTES.

"Vandergrift."—"Vandergrift: its homes and industries." This is the title of a brochure which has been produced in a very tasteful manner for the purpose of eulogising the glories of Vandergrift, and of enticing those who find old world conditions too monotonous, or as furnishing only fuel for discontented natures, to its rising industries and (passing ?) happiness and contentment. The publication has evidently been brought out with that intent, for it is issued by the Vanderdrift Land and Improvement Company. Vandergrift, by the way, is across the Atlantic, and is the home of the works of the American Sheet Steel Company, the Chilled Roll Foundry, and the Vandergrift Lumber Company. The work of the artist is found on nearly every page, and sets forth the natural beauties, the hills and slopes and weirs, the children romping in the sunshine, the carefully laid out streets and pretty homes, the chief buildings, the gun clubs, the factories where its industries are conducted, the pleasures in which its inhabitants engage, and the "peace and order" in which they live in this Utopia. One is apt to be carried away by the charms and attractions of the place, although the waters of the Kiskiminitas River seem rather low, and to imagine that it is an ideal spot, a heaven on earth, where the anxious "cease from troubling and the weary are at rest." Perhaps half an hour's stay there might tell another tale, but it may be thought unkind to throw cold water on so eulogistic an account by making such a suggestion.

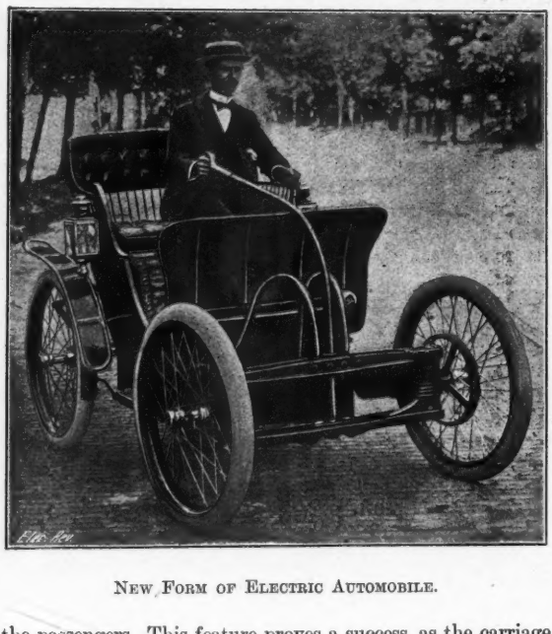
Boiler Explosions and Loss of Life.—From the 1899 report of the Engine Boiler and Employers' Liability Insur-

Personal. — Mr. Arthur Ellis, M.I.E.E., who has resigned the positions at Bolton of borough electrical engi-

S. Blatchford, £144; four transformers, the British Electric Transformer Company, £258.

"Anticipation" are inserted between "Novelty" and "Utility." As a matter of arrangement it

New Form of Electric Automobile.—This automobile (for the illustration of which we are indebted to the *Scientific American*) was constructed by Mr. D. L. Davis, superintendent of Salem Electric Light Company, of Salem, Ohio, who has been engaged in work upon it for the past 13 months. Its trial trip has been made, and our contemporary is told that it proved most satisfactory in its working. In the construction some new ideas have been carried out that are departures from those adopted by the American manufacturers of horseless vehicles. This new auto has a wheel base of 54 inches, and, owing to its different construction from other vehicles, its body is small and lower than customary, and the battery of 40 cells is below the axle line, thus doing away with the clumsy and top-heavy appearance of many horseless vehicles. The wheels are of steel, with heavy rubber tyres inflated. Two springs only are used, one on either side of the body and directly beneath



New Form of Electric Automobile.

the passengers. This feature proves a success, as the carriage is easy riding. It is in the application of power that the auto differs radically from American machines generally. The power is supplied by two 1-H.P. electric motors, which are connected with the front wheels, working independently of each other. The vehicle is also steered by the front wheels, which swing on pins close to the inside of the wheels, carrying the motors back and forth with them, the connection being made with brass contact plates which allow for the swing of the wheels. The framework is of tubing, which is carried from the body up to the top of the front axle, and through this tubing is carried the wiring from the batteries to the motors. The brake is stationary, the wheels being drawn up to the shoe when the brake is applied. The reversing lever also applies the brake. The general appearance of the vehicle is handsome, owing to its compact construction. Its weight is about 1,400 lbs.

Fatal Boiler Explosion at Sydenham.—At the Public Hall, Sydenham, on Monday, Mr. Howard Smith and Mr. Hallett, Commissioners, concluded their inquiry on behalf of the Board of Trade, into the circumstances connected with the boiler explosion on July 25th at the works of the Crystal Palace Electric Supply Company, Limited, by which two men lost their lives and several others were severely injured. Whilst a number of men were at work in a building on the works, unconscious of any defect in the boiler, it suddenly burst. The Commissioners, in giving judgment, found that the explosion was due in the first place to the faulty construction of the boiler, in certain parts of which cast-iron had been used. Messrs. Hornsby and Sons had explained that at the time—nine years ago—the boiler was constructed by them, they had in their employ an engineer whom they had afterwards dismissed for passing faulty work, but mainly the fault of the explosion lay with the Crystal Palace Electric Supply Company. Mr. Phillips, their manager, was responsible for the upkeep and maintenance of the boiler, but he was an electrical engineer and had no previous knowledge of boilers. He depended on the report chiefly from the insurance company, and evidence had been given that the recommendations in one of the reports of the National Insurance Company, by whom the boiler had previously been insured, had not been complied with. He had also stated that he had had no knowledge of this report, but they (the Commissioners) thought it must have come to his knowledge and that he had forgotten it. Blame was also attached to the inspector of the Engine Boiler Insurance Company, who had not made, in their opinion, adequate examination of the boiler. The Electric Supply Company was ordered to pay £150, and the Engine Boiler Insurance Company £50, towards the cost of the inquiry. Messrs. Hornsby and Sons were not adjudged liable in costs as the boiler had been made by them so long ago.

We cannot express unqualified approval of the above decision. True, the boiler was made nine years ago; but seeing that the makers in their evidence distinctly admitted that the boiler was of defective construction from the very start, we fail to see why they should be held blameless. Indeed, the very first sentence of the Commissioners' judgment apparently throws a large share of the responsibity upon the makers of the boiler! Moreover, the witnesses for the Board of Trade stated that even if wrought-iron had been used in certain parts, instead of cast-iron, the boiler when new was not fit for a pressure of more than 73 lbs. per square inch, but the makers had certified it for a pressure of 140 lbs., at which it was being worked. They further stated that the boiler, as designed, had practically to be taken to pieces before it could be thoroughly examined. Under these circumstances it is difficult to see how an explosion could be obviated, no matter how careful the management.

Electrical Engineers as Riflemen.—The Electrical Engineers R.E. (Vol.) had their first rifle competition while in camp at Plymouth last week. A challenge was sent them by the Three Towns and District Rifle Club, and the competition came off on August 29th at the Naval Range at Trevol. C.S.M. Field made the arrangements for the Engineers and Mr. F. Clase for the Club. A large number of club members were present, as well as Major Erskine and Lieut. Pearce.

Team Electrical Engineer Volunteers.

	Range 200 yards.	500 yards.	600 yards.	
C.S.M. Field	22	31	19	72
C.S.M. Pontifex ...	30	23	26	79
Serg. Merrit	23	29	14	66
Serg. Lister	30	22	21	73
Corp. Moberley	28	20	16	64
2nd Corp. Smith ...	16	6	21	43
Sap. Lynn	26	22	29	77
Sap. Chubb	19	16	16	51
Grand total ...				525

Three Towns Club.

Boolds, C.	20	13	10	43
Good, J.	20	22	5	47
Rose, J.	23	25	17	65
Hertzel, C. H. A. ...	21	25	20	66
Sullivan, T. D.	7	20	18	45
Greenlaw, F.	23	14	2	39
Clive, E.	22	31	23	76
Clase, F.	24	23	22	69
Grand total ...				450

Light variable wind from left. Cloudy day.

We understand that it is proposed to inaugurate a rifle club in connection with the corps and to arrange for regular practice, when, no doubt, further competitions will follow. This will certainly have the hearty support of everybody who desires to see the Old Country retain the foremost place amongst the civilised nations of the world.

Appointments Vacant.—An assistant engineer and other employés are wanted for the Accrington municipal electricity works. See "Official Notices" to-day.

An instructor in electro-metallurgy and a laboratory demonstrator are wanted at the Northampton Institute, Clerkenwell. See "Official Notices."

before they let it cool down. In a large city like Man-

Will.—Probate of the will of the late Mr. Gustavus

Office style. Such forms are of incalculable value to a

so eulogistic an account by making such a suggestion.

Boiler Explosions and Loss of Life.—From the 1899 report of the Engine Boiler and Employers' Liability Insurance Company it appears that the company insures 18,000 boilers. For the first 20 years of its work the life lost was only 0·3 of one life per year. The average loss of 21 years, however, was raised to 0·62 by one singularly fatal collapse in 1899. The collapse was that of a Lancashire boiler 25 years old. It was due to shortness of water, and killed seven people. The water gauge taps were in bad order, and the correct water level was not shown. The low record of 0·62 life per year is an excellent showing for voluntary insurance. The collapse that prevented the record being but half this low figure would not have occurred had the insurance company's "strong recommendation" been attended to as regards internal cleaning. We are glad to see that this company has now added a certification to its insurance. The company wisely continues its insurance and inspection of boilers, and is often no doubt the means of preventing accident; but it does not grant its certificate to doubtful boilers. In this way the company escapes the onus of receiving premiums for doubtful boilers for the sake of business. Foolish people have pointed to the insuring of a boiler as equal to a guarantee of its soundness; they have argued that no company would take the risk of an unsafe boiler. This, of course, is nonsense. The risk is small when spread over 18,000 boilers, and business is business and not philanthropy. But by adding a certificate to its insurance, the company has done a wise thing. It avoids the forgoing reproach: it continues to keep many risky boilers under some surveillance, and exercises an educational influence by its inspectors' constant visits, while, by withholding the certificate, it hangs a remonstrance over the head of the owner that will follow him into the court of inquiry should his boiler fail, and must do much to cause him to take precautions to avoid it. A case is cited in which an inspection of a satisfactory order of an insured boiler was not obtained for years. It is added that "but for keeping the boiler insured and pegging away at the owner it is probable no examination would ever have been made, and the boiler would have been kept at work till it exploded." It cannot be doubted that the boiler insurance companies have in the main acted rightly, and that but little more pressure needs to be brought upon owners to compel the laggard ones to toe the line of responsibility. Such should be possible without any inconvenience to those who have so realised their duties.

Murray's Long-Distance High-Speed Page-Printing Telegraph.—In this system, the invention of Mr. Donald Murray, of Australia, the message is first perforated on a tape and then passed through a transmitter as in the Wheatstone automatic system; at the receiving instrument the currents reproduce the signals in the form of perforations on a second tape similar to the transmitting tape; from this second tape the signals are printed in ordinary type, in page form, by means of an automatic typewriter, which practically constitutes the novelty of the invention. The apparatus for perforating the transmitting tape is in the form of a typewriter, and the perforations made form either a series of detached holes or a series of holes close together and overlapping, the latter constituting a dash. The transmitting apparatus has actually been worked at a speed of 114 words per minute over a line 388 miles long, and then translated automatically into type-written characters at a speed of about 60 words per minute. The speed of 114 words per minute over 388 miles of line, it is perhaps unnecessary to say, is not a high commercial rate, though doubtless it is a high rate at which to be able to reproduce perforations on a tape. The fact that these perforations can be converted into type-written matter at a rate of 60 words per minute is, however, a decidedly good result, as it is a higher rate than that at which ordinary Wheatstone slip can be transcribed; so far, therefore, the apparatus appears to have great possibilities, and further developments of it will be looked forward to with interest. It should be added that the apparatus employs 84 characters, including capitals, small letters, and figures; with tissue carbon paper, from 15 to 20 copies may be made in the one act of printing. The inventor, like most other inventors, claims that "the mechanism is extremely simple, durable, and easy to keep in order."

Personal. — Mr. Arthur Ellis, M.I.E.E., who has resigned the positions at Bolton of borough electrical engineer and general manager of the electric tramways, to accept a post under the Cardiff Corporation as electrical engineer, was on Sunday forenoon made the recipient of a very handsome testimonial subscribed for by the employés in the departments over which he had control. The gathering took place at the Bolton Corporation tram sheds, and, owing to the want of accommodation met with in consequence of all the cars being in the shed, those joining in the ceremony had to take seats on the top of the tramcars in the place. Mr. Harry England, traffic manager for the Corporation tramways, was voted to the chair, and those supporting him included Mr. Angus, chief assistant electrical engineer to the Bolton Corporation. Mr. Robert Tootill, a member of the Town Council, was also present. The chairman, in making the presentation, which took the form of a solid silver tea and coffee service, referred to the difficulties which Mr. Ellis had had to contend with in the inauguration of a system of electric trams for the town, adding that the public, and others more intimately connected with the undertaking, expected far too much. In the starting of a scheme of such magnitude, they could not have all plain sailing, especially seeing that they had to run the new electric cars on the old track. He believed, however, that all present would agree with him when he said that after eight or nine months' experience they were running the cars as satisfactorily as could reasonably be expected under the circumstances. Mr. Angus supported the presentation as representing the electricity department. In acknowledging the presentation, Mr. Ellis said he deeply appreciated the feeling which had prompted the subscribers to that gift. He was sorry to leave Bolton, particularly to part with the staff which had worked so well with him. He only hoped that he would have as good men where he was going as he had had at Bolton.

It should be added that at the last meeting of the Electricity Committee of Bolton Town Council a resolution was adopted expressing the members' regret that Mr. Ellis was leaving Bolton, and wishing him every success in his new appointment.

Out of 75 applicants Mr. J. H. Cawthra, chief assistant engineer to the Leeds Corporation, has been appointed resident engineer to the Swansea Corporation electricity works.

In view of his approaching marriage, Mr. Watts, resident engineer of the Alderley Electric Supply Company, Limited, was recently presented with a valuable gold watch chain by his colleagues and other friends at a meeting held in his honour.

On Friday last week, at St. Helens, a handsome solid silver cruet and set of fish carvers were presented to Mr. B. Welbourne, who has been in charge of the overhead equipment of the tramways, by his staff and friends, in connection with his appointment to a responsible post in the B.I.W. Company's works.

The Manchester Load Curve.—The following letter comes to hand too late for insertion in our "Correspondence" columns:—"I was much interested in the load curve that you gave in your last issue, and agreed that so far as the watts are concerned, it shows what the Dickenson Street staff can do at short notice. I am, however, entirely dependent upon the electric supply for a light whenever the solar supply is from any cause interrupted, and on this occasion I wish that I could have supplemented Mr. Wordingham's curve with a copy of the volt-curve for the same time in my office. Although I am unable to do this, I can testify to the fact that three 8-c.p. lamps did not yield so much light as one of them can on normal occasions. The volts in a manner represent the possible candle-power of the lamp, and it is impossible to obtain the normal intensity if the volts are low, then why should not the systems of payment include a fine upon the authorities whenever the volts are low? The discount so obtained would help to pay for the candles, &c., required to supplement the glow lamps in instances of storms, &c. The case is, however, one of the many that, in my opinion, go to show that the majority of central station engineers are working without a sufficient reserve of steam-power to deal with instances of sudden darkness, and that if they wish to earn a reputation for being always ready, they must take into consideration the time that is required to get up steam in each boiler

Cost of Production.

The wages of the entire staff in the station are debited to works costs, while the whole of the engineer's salary is included under

before they let it cool down. In a large city like Manchester, during the day, in case of sudden fog, the load may easily reach its maximum in a few minutes, because the offices and warehouses are situated comparatively close together, and they will be in consequence affected practically simultaneously by any change in the conditions of the weather. All these stations ought to be provided with a weather scout, as in this city, at least, there have been within my knowledge many instances in which the man in the street could have given the station authorities 2 or 3 hours' notice of the approaching darkness, which would have sufficed to have met the emergency so far as Manchester is concerned, judging by the curve. If the storm of the 21st ult. had come three hours earlier, I am rather inclined to think the case would not have been so good as it was, because under ordinary circumstances the load curve would not have then been rising, and the chances are very strongly in favour of the boilers not being ready for being pushed. There may be a very strong temptation for the staff of central stations to become "coal dodgers" in their desire to figure well in the analytical sheets that some of your contemporaries delight in, and to forget that there are other items in the efficiency of their department than the weight of coals consumed."—Spectator.

Building Trades' Gift to the Nation.—Electrical Section.—We have received from the hon. secretary of the Electrical Section of the Building Trades' Gift a list of those who, up to August 29th, have promised contributions in kind or in money to the Bisley Homes of Rest for disabled soldiers, in response to the appeal circulated a month ago. Previous donations have already been published in the Review. The following have now promised gifts of money, and those whose names are marked with an asterisk have already paid the specified contribution:—

Braby, Mr. Ivon	£1	1	0
*Cardew, Major P., R.E.	1	1	0
*Denny, Mr. A.	1	0	0
Elliott Bros., Messrs.	5	5	0
*Gavey, Mr. J.	1	1	0
Gorham, Mr. J. M.	10	10	0
*Gray, Mr. R. K.	20	0	0
Hartnell, Mr. Wilson	2	2	0
Madgen, Mr. W. L.	5	5	0
*Snell, Mr. Albion T.	1	1	0
Swan, Mr. J. W.			
*Swinburne, Mr. J.	2	2	0
Wallis-Jones, Mr. R. J.	5	5	0

The following have promised gifts in kind:—

Bell's Asbestos Company, Limited	... The lagging for the piping.
The Electrical Company, Limited	... Incandescent lamps.
Faraday & Son	... Six hand lamps with flexible cord.
Geipel & Lange	... Steam traps.
Holden & Brooke	... Two No. 3 Sirius brass injectors.
Lloyd & Lloyd, Limited	... Certain steam and water tubes.
Newton Electrical Works, Limited	... Dynamo.
Perry & Co.	... 15 standard lamps with shades, &c.
Western Electric Company ...	... ½ mile of rubber cable.
Willcox, W. H., & Co., Limited ...	... Engine room fittings.
Zurich Incandescence Lamp Company	... 250 incandescent lamps.

We cordially recommend this most deserving object to the notice of our readers. It may be said by some that enough has been done in the way of contributing to funds in aid of our soldiers; but has the fighting ceased? The war is not yet over, and there is a steady stream of disabled men returning to our shores; let us see to it that, so far as we are able, a haven of refuge is prepared for them. We can never compensate them for their broken limbs, but we can provide them with a comfortable home.

Marriage.—On September 5th, at St. Mary's Church, Sunbury-on-Thames, Mr. Herbert W. Watts, engineer and manager of the Alderley Edge Electricity Works, Cheshire, only son of William Watts, of Kingston-on-Thames, was married to Eva Maud, eldest daughter of Herbert E. Saunders, of Shepperton-on-Thames, formerly of Surbiton, Surrey.

The Jungfrau Railway.—It is rumoured that on account of the enormous cost of the works, the completion of this ambitious project will be indefinitely postponed.

Will.—Probate of the will of the late Mr. Gustavus Adolphus Steinthall, of 30, Hall Field Road, and 41, Piccadilly, Bradford, electrical engineer, who died on May 28th, 1900, has been granted. The gross value of the estate is returned at £6,426 4s. 8d., and the net personality at £3,818 17s. 1d.

NEW COMPANY REGISTERED.

Fylde Painting, Plumbing and Electrical Engineering Company, Limited (67,066).—This company was registered on August 27th, with a capital of £500 in £1 shares, to carry on the business of painters, plumbers, decorators, plasterers, electricians, mechanical and electrical engineers, suppliers of electricity, &c., at Blackpool or elsewhere. The first subscribers are:—J. King, 69, High Street, Blackpool, painter, with 15 shares; J. C. Rossler, 21, Manchester Road, Blackpool, painter, with 15 shares; W. C. Procter, 95, Talbot Road, Blackpool, painter, with 10 shares; W. J. Cunliffe, 16, Lancaster Avenue, Blackpool, with 10 shares; H. O. Helliwell, 16, Victoria Street, Blackpool, painter, with 15 shares; R. Johnson, 37, Ribble Road, Blackpool, painter, with 10 shares; and R. Hallas, Garden Terrace, Bispham, Blackpool, painter, with 10 shares. The number of directors is not to be less than three nor more than five. The first are Richard Hallas, John C. Rossler, John King (chairman), Abraham Wood, and Henry O. Helliwell; qualification, £10. Registered office, 16, Lancaster Avenue, Blackpool.

SUPPLY STATION ACCOUNTS.

Hampstead Vestry Electricity Accounts.

The accounts of the Hampstead Vestry electricity supply undertaking show that the progress made last year exceeded that in the preceding year, good as that was. The works are being rapidly extended. Thus in 1898 £25,233 was spent, while in 1899 £36,802 was added to the capital expenditure, which now stands at £162,212, being about £79 per kilowatt installed. Tenders have been let for extension plant comprising four 500-kw. alternators with Belliss engines, six Davey-Paxman boilers, each capable of evaporating 10,000 lbs. of water per hour, water softening plant, evaporative condenser, economiser, and sundry details, all of which are in process of erection and some nearly complete.

General Statement.

	1898.	1899.	Increase.
Total capital expenditure ...	£125,410	**£162,212**	£36,802
Number of units sold	1,001,916	**1,418,442**	416,526
Maximum load in kw.	917	**1,198**	281
Number of lamps connected ...	83,576	**104,579**	21,003
Gross revenue	£23,752	**£30,660**	£6,908
Gross expenditure	£10,751	**£14,336**	£3,585
Gross profit	£13,001	**£16,324**	£3,323
Average price per unit sold ...	5·49d.	**4·98d.**	− ·51d.

The output in 1898 increased nearly 50 per cent., and although it could not be expected that this rate would be maintained, the increase last year was about 40 per cent., while the maximum load is rising less rapidly, showing that the reduction in price for private supply (which actually took place three months before the end of the financial year now being considered) has encouraged a more general use of electric lighting, and the demand indicator system has led to an improvement in the load factor. The price for public lighting was reduced at the end of the 1898 financial year. The effect of these alterations in charges has been a fall of just over a halfpenny in the receipts for the energy sold. There are now 89 public lamps which took 122,232 units, leaving 1,296,210 as sales to private consumers in 1899.

Revenue Statement.

	1898. Gross.	1898. Per unit.	1899. Gross.	1899. Per unit.	Increase.
Sale of energy	£22,919	5·49d.	**£29,429**	4·98d.	− ·51d.
Meter rents, &c...	802	·19d.	**1,109**	·19d	·00d.
Supply of fittings, &c.	...	...	...	...	...
Sundry fees and interest received	31	·00d.	**122**	·02d.	+ ·02d.
Gross revenue ...	£23,752	5·68d.	**£30,660**	5·19d.	− ·49d.

The costs of production are mainly affected by a considerable reduction in the gross amount for "repairs and maintenance," some £168 less than in the previous year, and this has enabled the works and total costs to be brought down roughly by (·15d.), the same amount that the item appears in the "increase per unit" column. Coal is practically stationary at 1¼d., the enhanced price per ton, evidently balancing the more economical use of fuel with the larger output.

Cost of Production.

	1898. Gross.	Per unit.	1899. Gross.	Per unit.	Increase.
Coal	£5,131	1·24d.	£7,357	1·25d.	+·01d.
Oil, waste, water and engine room stores.	574	·14d.	856	·14d.	·00d.
Salaries and wages incurred in generation and distribution.	1,313	·31d.	1,898	·32d.	+·01d.
Repairs and maintenance of buildings, engines, boilers, dynamos, and street lamps	1,889	·45d.	1,721	·29d.	−·16d.
Works costs ...	£8,907	2·14d.	£11,832	2·00d.	−·14d.
Rent, rates and taxes ..	353	·08d.	381	·07d.	−·01d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	991	·24d.	1,308	·22d.	−·02d.
General establishment charges, stationery and printing, law charges and insurance	480	·12d.	711	·12d.	·00d.
Other expenses, certification of meters, stamp duty on loans, &c.	20	...	104	·02d.	+·02d.
Total costs ...	£10,751	2·58d.	£14,336	2·43d.	−·15d.

The net profit, notwithstanding the reduced rate of charge, has been increased to £9,357 as against £8,340 in 1898. This was dealt with as follows:—£6,000 were transferred to the reserve fund, £873 were paid over to the capital account to cover deficits on loans, £218 were allotted to cover expenditure on arc lighting works in the year 1898, while the balance was added to the previous net profit of £11,160, and out of the sum so obtained £10,221 were placed to the reserve fund (making the total amount £16,221, representing 10 per cent. on the capital expenditure), and £3,205 were paid as a first instalment to the depreciation fund (being £400 on account of meters and £2,805 in respect of machinery and plant).

Profit Statement.

	1898.	1899.
Interest on loans, &c.	£3,464	£4,071
Sinking fund for repayments	1,197	2,896
Net profit carried to reserve fund and depreciation account.	...	8,266
Net profit carried to deficits on loans ..	...	873
" " " expenditure on arc lighting works.	...	218
Net profit carried forward	8,340	...
Gross profit	£13,001	£16,324

South Shields Corporation Electricity Accounts.

The accounts of the electricity supply undertaking of the Corporation of South Shields give evidence that the turning point in this case, as in many others, will be reached in the current year, and that when the next accounts are dealt with, the present net loss should change its sign, and become net profit. The progress made in the last three years is good, and can be readily appreciated by the following summary of figures:—

	Units generated.	Units sold. Private.	Public lamps.	Maximum load.	No. of public arc lamps.	Gross profit.	Net profit.
1897 ..	153,338	82,179	41,729	127 kw.	31	£144	−£1,676
1898 ..	391,687	200,808	107,800	323 kw.	63	£2,149	−£882
1899 ..	634,464	394,089	107,800	500 kw.	69	£4,231	−£73

In 1898 a large number of licensed premises was connected, while the lamps used for public lighting were doubled. The capital expenditure is moderate.

General Statement.

	1898.	1899.	Increase.
Total capital expenditure ...	£58,699	£88,687	£29,988
Number of units sold	308,108	501,839	193,731
Maximum load in kw.	323	500	177
Gross revenue	£5,231	£8,183	£2,952
Gross expenditure...	£3,082	£3,952	£870
Gross profit	£2,149	£4,231	£2,082
Average price per unit sold ...	3·99d.	3·72d.	−·27d.

The gross revenue has increased by nearly £3,000, notwithstanding that the average receipts per unit from private supply alone have fallen from 4·48d. in 1898 to 3·85d. in 1899. This has affected the gross receipts per unit by ·16d., $\frac{1}{10}$d. in the "Sundry fees, &c.," item coming from a sum of £211 "allowed for delay in delivery of plant, less expenses in connection therewith."

Revenue Statement.

	1898. Gross.	Per unit.	1899. Gross.	Per unit.	Increase.
Sale of energy	£5,126	3·99d.	£7,766	3·72d.	−·27d.
Meter rents, &c.	100	·08d.	203	·09d.	+·01d.
Supply of lamps, &c.	...	...	...	...	...
Sundry fees	5	·00d.	214	·10d.	+·10d.
Gross revenue ...	£5,231	4·07d.	£8,183	3·91d.	−·16d.

The wages of the entire staff in the station are debited to works costs, while the whole of the engineer's salary is included under "management," as the Local Government Board will not now allow any portion of the salary of a permanent official to be borrowed except when a station is first put down. A sum of £50 is charged for the services of the accountant, so it cannot be said that the electric lighting department is unduly favoured. The costs show a reduction of ¼d. on "works," and just over ¼d. on the "total," a result upon which Mr. J. A. Jeckell, the engineer, must be congratulated, as well as upon having reduced the deficit on the financial year to £73. Over rent, rates, &c., an engineer has little control, and this is the only item showing an increase.

Cost of Production.

	1898. Gross.	Per unit.	1899. Gross.	Per unit	Increase.
Coal	£585	·46d.	£923	·44d.	−·02d.
Oil, waste, water and engine room stores.	230	·18d.	229	·11d.	−·07d.
Salaries and wages incurred in generation and distribution, and in attending street lamps	1,058	·82d.	1,194	·57d.	−·25d.
Repairs and maintenance of buildings, engines, boilers, dynamos, and public lamps, &c.	202	·16d.	315	·15d.	−·01d.
Works costs	£2,075	1·62d.	£2,661	1·27d.	−·35d.
Rent, rates and taxes ..	153	·12d.	287	·14d.	+·02d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	587	·45d.	702	·34d.	−·11d.
General establishment charges, stationery and printing, law charges and insurance.	267	·21d.	302	·14d.	−·07d.
Other expenses	...	...	...	...	...
Total costs ...	£3,082	2·40d.	£3,952	1·89d.	−·51d.

The financial charges have been increased by £1,273, but owing to the gross profit having almost exactly doubled, the deficit is now almost negligible, as alluded to above.

Profit Statement.

	1898.	1899.
Interest on loans	£1,466	£2,129
Sinking fund for repayment	1,565	2,175
Net profit carried forward	−882	−73
Gross profit	£2,149	£4,231

CITY NOTES.

Marconi's Wireless Telegraph Company.

An extraordinary meeting of the above company was held on Wednesday at 18, Finch Lane, E.C. According to the *Financial News*, Major S. Flood-Page, who presided, said that the board had resolved to issue 25,000 shares, which would be offered in the first instance to the shareholders *pro rata* at £3 per share. A provisional agreement had been entered into with a firm of brokers, who would guarantee 12,500 of the 25,000 shares at £3 each. This was a *bonâ fide* offer from a firm of position, and showed the estimate put upon the value of these £1 shares. The company had contracted with the Navy for the application of the system to 28 ships and four land stations. There would soon be stations equipped with the Marconi apparatus which would enable the Admiralty to communicate practically from Dover to the Scilly Islands, or about one-fourth of the whole coast-line of England and Wales.

Clontarf and Hill of Howth Tramway Company.

At the second half-yearly meeting of this company held at Dublin last week, Sir F. W. Brady, Bart., who presided, said that the permanent way and works were virtually completed early in the year. The necessary rolling stock was ordered over 12 months ago, and should have been delivered last April in good time for the opening of the line, which they contemplated would not be later than June 1st. Electricity as a motive power had made such rapid strides within the last few years that the manufacturers, with the works and plant at present at their disposal, were not able to cope with the work on hand, and they disappointed them, and delivered the cars contracted for 12 months ago only quite recently. However, the cars which they delivered are by far the best of any which had come to Dublin up to the present. The line was formally opened for traffic on July 26th last, and notwithstanding the very bad weather they had experienced at the commencement, they were now doing exceedingly well. The receipts for four weeks and five days amount to £1,078, and although they carried 95,000 passengers, they had not had a sufficient supply of rolling stock to start with. The had now, however, the full supply of cars delivered, and hoped to be able to handle any traffic that may arise henceforward. The Howth line would, of course, have to depend chiefly on summer traffic, but as the capital of the company was small and the working expenses comparatively low, the shareholders might look forward to satisfactory dividends out of the summer traffic alone. Under the special Act the tramroad was their property for ever, and not for a period of years, as in the case of an ordinary tramway. The com-

SHARE LIST OF ELECTRICAL COMPANIES. TELEGRAPH AND TELEPHONE

pany would, therefore, have all time to benefit by the development and increase of population, which was sure to follow on the construction of the tramways. As the line was not working during the last half-year, to which the accounts refer, there was no revenue account to submit. The capital account showed that the whole of the share capital of £50,000 and £21,000 out of £25,000 of debentures were issued; £45,000 had been called up on the shares, and at June 30th £2,076 was due on calls, but the calls had nearly all since been paid. The Great Northern Railway Company are constructing an electric tramroad round the Hill of Howth, which it is expected will be opened for next season's traffic.

The Chloride Electrical Storage Syndicate, Limited.

The directors, in presenting to the shareholders their report for the year ending June 30th, 1900, state that during the year the business of the syndicate has continued to increase in a very satisfactory manner, the amount of orders received and goods manufactured being considerably greater than in any previous year. The capability of production at the works has been taxed to the utmost to meet the demand, and a large volume of orders has either gone by the syndicate or been refused by it, owing to its inability to execute them within a reasonable period. To meet the continually increasing demand, considerable extension of the works and plant is becoming an imperative necessity, as also additional working capital. Negotiations have been entered upon for acquiring additional land adjoining the syndicate's works. The balance-sheet shows that the profits for the year, after providing for debenture interest, amount to £8,649 15s. 5d., which the directors consider satisfactory, when the large increase in the cost of raw material and the conditions of production which have obtained during the year under review are taken into consideration. These, together with the execution of contracts arranged in 1897 and 1898 previous to the advance in prices, have seriously militated against the year's profit. After writing off from several accounts £4,391 2s. 1d. (an amount which the directors think necessary) there remains a balance of £4,258 13s. 4d., to which must be added £7,026 10s. 5d. brought forward from last year, making £11,285 3s. 9d. The directors propose to carry forward the balance, out of which a dividend may be paid at their discretion. The retiring director is Mr. John Shepherd Baker, who offers himself for re-election. The auditors, Messrs. Parkinson, Mather & Co., also retire and offer themselves for re-election.

The annual general meeting of the shareholders was held at the works and registered office, Clifton Junction, near Manchester, on Tuesday, the 28th ult., the chairman of the company, F. H. Bowman, Esq., D.Sc., F.R.S. (Edin.), presiding.

The notice convening the meeting having been read, the directors' report and accounts were received and adopted. The retiring director, Mr. J. S. Baker, and the auditors were re-elected, and votes of thanks passed to the chairman and directors, and also to Mr. Grindle (the general manager), the secretary, and staff.

Stock Exchange Notices.—The Stock Exchange Committee has appointed a special settling day as under:—Thursday, September 13th, Metropolitan Electric Supply Company, Limited. —Further issue of £125,000 3½ per cent. mortgage debenture stock, and has also ordered the under-mentioned to be quoted in the Official List: Crompton & Co., Limited.—Further issue of 21,902 shares of £3 each, fully paid, Nos. 32,099 to 54,000. Metropolitan Electric Supply Company, Limited.—Further issue of £125,000 3½ per cent. mortgage debenture stock.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending September 1st, 1900, were £1,519 12s. 1d.; receipts for corresponding period, 1899, £1,471 7s. 2d.; aggregate for half-year to date, £13,125 3s. 8d.; aggregate corresponding period of last half-year, £13,462 5s. 5d.

The Bristol Tramways and Carriage Company.—The receipts for the week ending August 31st, 1900, were £3,455 8s. 9d.; corresponding period, 1899, £3,498 1s. 8d.; decrease, £42 12s. 11d.

The Central London Railway.—The receipts for the week ending September 1st, 1900, were £4,499; previous week, £4,385; increase, £114. Total receipts (5 weeks), £22,838. Miles open, 6.

The City and South London Railway Company.—The receipts for the week ending September 2nd, 1900, £1,528; September 3rd, 1899, £891; increase, £637. Total receipts for half-year, 1900, to date, £13,536; corresponding period, 1899, £8,553; increase, £4,983. Miles open, 1900, 4½; 1899, 3½.

The Cork Electric Tramways and Lighting Company.—The receipts for the week ending Thursday, August 30th, 1900, were £493 2s. 7d.; corresponding week last year, £518 15s. 9d.; decrease, £25 13s. 2d. Total to August 30th, 1900, £14,195 9s. 5d.; corresponding period last year, £13,021 17s. 2d.; increase, £1,173 12s. 3d.

The Dover Corporation Tramways.—The receipts for the week ending September 1st, 1900, were £289 0s. 10d.; September 1st, 1899, £293 4s. 11d.; decrease, £4 4s. 1d. Total receipts to date, 1900, £7,123 12s. 1d.; corresponding period, 1899, £6,781 5s. 8d.; increase, £342 16s. 5d. Miles of track open, 1900, 8; 1899, 8. Car miles run, 1900, 5,161; 1899, 4,932. Number of cars, 1900, 11; 1899, 11.

The Dublin United Tramways Company.—The receipts for the week ending Friday, August 31st, 1900, were as follows:—D. U. T. Co., horse cars, £29 13s. 0d.; ditto, electric cars, £4,227 3s. 0d.; D. S. D. Co., electric cars, £1,629 19s. 7d.; total, £5,886 16s. 1d; corresponding week last year—D. U. T. Co., horse cars, £1,835 3s. 3d.; ditto, electric cars, £1,743 0s. 9d.; D. S. D. Co., electric cars, £1,121 15s. 2d.; total, £4,699 19s. 2d.; (Horse Show, 1900); increase, £1,186 16s. 11d.; aggregate to date, £45,755 8s. 2d.; aggregate to date last year, £42,179 10s. 4d.; increase to date, £3,575 17s. 10d. The mileage worked is 43 miles electrically, 1 mile by horses, as against 21 miles electrically, 23 miles by horses, for the corresponding period last year.

The Halifax Corporation Tramways.—The receipts for the week ending September 2nd, 1900, were £844; corresponding period, 1899, £721; increase, £123. Total receipts to date, 1900, £17,548; corresponding period, 1899, £13,782. Miles of track open, 1900, 14; 1899, 6¾. Number of cars, 1900, 29 1899, 14.

The Liverpool Overhead Railway Company.—The receipts for the week ending September 2nd, 1900, were £1,735; corresponding week last year, £1,994; decrease, £259. Total traffics from July 1st, 1900, £15,695; ditto corresponding period, 1899, £15,655; increase, £40.

STOCKS AND SHARES.

Wednesday Evening.

The hardening tendency of the general Stock Exchange markets to which we drew attention last week is still in evidence. Headed by a steady improvement in Consols and other gilt-edged securities, investment stocks have crept up, their latest strength being quite sufficient of itself to justify their joining in the speculative department's rise on the formal annexation of the Transvaal. The latter event caused general congratulation in the Stock Exchange, and was followed—so far as the electric markets are concerned—by a rise in Cape Town tramway shares. The buyers of these declare that immediately the War is over, Cape Town will become the centre of an enormous trade, which cannot fail to proportionately benefit the tramway company. Beyond this little feature there is no special attention due to this section of the market. British Electrics have quieted down after their rise of last week. Dealings in the new shares have now ceased for all practical purposes, seeing that this issue will be the same as the old in all respects next week.

The supply market retains its firmness, and Notting Hill shares are throwing off some of the fall which lately overtook them. The new shares are better at 1¼—1⅜ premium. For the "heavy" descriptions—Westminsters, St. James's, Metropolitans, &c.—there has been a fair sprinkling of buyers in the market during the last few days. This has been caused in part by the easing off of the rates in the money market, and the much stronger position now occupied by the Bank of England. In fact, the Stock Exchange is now quite as willing to laugh at the threatened "autumn stringency" as it was to quake at the very thought 10 days ago. Should the ease in Lombard Street continue, there would no doubt be a general advance, more particularly in the debenture stocks of the Supply Companies, and some people are already taking time by the forelock in this anticipation.

Why Eastern Telegraph Ordinary stock should have been marked up a point, we confess ourselves quite at a loss to explain, because no change whatever has taken place in the dealing price, which still remains 147 to 149, the same as it was when we last wrote. Of course, the official quotation is only a nominal one; it does not express the actual value of the stock, as may be seen by the fact that the former quotation can be raised ¼ per cent. while the real price remains unaltered. The Eastern Extension group is inanimate, nor has all the China trade which has recently sprung up affected the price of the shares more than an eighth. The market is canvassing the dividend prospects of Anglo-American Telegraph Deferred, *i.e.*, the "A" stock, which will be due next February, and the latest estimates are about ⅝ or ¾ per cent. Eight months ago the company paid 28s. per cent., but it is morally impossible for it to distribute more than half this amount in the new year. Upon this consideration, the stock is being maintained in the neighbourhood of 12½, which appears to us to be quite high enough.

Central London shares are harder upon a more philosophic view being taken as regards the traffics of the line, which, it is now stated, can hardly be maintained at the first week's figures, when the line was London's latest plaything. The figures for the current week, showing an increase over the one previous, were regarded as very satisfactory, and the close price on Wednesday night was 10⅛ to 10¼. Waterloo and City Stock is making up some of its recent drop, under the influence of easier money, and an improving Home Railway market. With its certain 3 per cent. dividend, the stock yields an investor a shade under £3 4s. per cent., by no means an alluring return in these days of cheap gilt-edged investments.

In the manufacturing division, Henley's are ½ down, on the issue of new shares at par now being made. It is, by the way, becoming a Stock Exchange axiom that fresh emissions of capital are followed by a fall in the price of existing shares. The new Henley's are quoted ⅝ to ¾ premium, and are certainly worth while taking up. A limited market exists for them, and to sell at ⅝ premium is to present the buyer with very cheap shares. Indeed, it would probably pay the allotter better were he to buy more, and there are many doing this, selling their old shares to provide the necessary money.

National Telephone shares are offered at 4⅜, and the steady advance of the Government telephone wires in the City is frightening some of the nervous holders in the National Company. Other telephone shares are scarcely mentioned.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1897.	1898.	1899.	Closing Quotation August 29th,	Closing Quotation September 5th.	Business done during week ended September 5th, 1900. Highest.	Lowest.
110,900	African Direct Telegraph, 4 % Debs.	100	...	...	...	99 —103	99 —103	99	...
125,000	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	85 — 90	85 — 90	...	...
875,520	Anglo-American Telegraph	Stock	3 %	£3 9s.	73/6	58 — 61 xd	58 — 61	59⅜	...
3,062,240	Do. do. 6 % Pref.	Stock	6 %	6 %	6 %	110½ 111½xd	110½—111½	111¼	110⅝
3,062,240	Do. do. Deferred	Stock	...	18s. %	£1 7s.	12¼— 12⅜	12¼— 12⅜	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	3 %	4 %	2½— 3½	2½— 3½	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	...	165 —175	165 —175	...	...
1,563,078£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	101 —103	101 —103	102½	101½
16,000	Cuba Telegraph	10	7 %	8 %	7 %	6½— 7½	6½— 7½	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	...	15 — 16	15 — 16	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	...	...	9 — 10	9 — 10	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	100 —104 %	100 —104%	...	...
60,710£	Direct United States Cable	20	3¼%	3¼%	3 %	11 — 11½	11 — 11½	11¼	11
111,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	99 —102	99 —102	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	145 —150	146 —151	149	146
1,795,000	Do. 3½ % Pref. Stock	100	...	...	...	97 —100	97 —100	100	99½
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	...	...	111 —116	112 —117	115	...
250,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	14⅜— 15¼	14⅜— 15¼	15⅛	14⅞
6,700£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	...	...	... — ...	... — ...	...	...
26,600£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	...	...	... — ...	... — ...	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	...	...	110 —115 xd	111 —116	...	...
300,000£	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	...	...	...	99 —102 xd	99 —102	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	100 —103%	100 —103%	...	...
180,227	Globe Telegraph and Trust	10	4½%	5⅛%	5¼%	11 —11½	11 — 11½	11¼	11⅛
180,042	Do. do. 6 % Pref.	10	6 %	6 %	...	14⅜— 15¼	14⅜— 15¼	15⅛	14⅞
150,000	Great Northern Telegraph, of Copenhagen	10	10 %	12½%	...	31 — 33	32 — 34	32	...
84,300	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	98 —101	98 —101	100¾	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	51 — 55	51 — 55	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	...	...	105 —108	103 —106 xd	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680	1	...	...	...	¼— ½	¼— ½	...	...
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	4 %	4 %	2½ %	¾— 1	¾— 1	...	...
490,000	National Telephone, 1 to 490,000	5	6 %	6 %	5 %	4⅝— 4⅞	4⅝— 4⅞	4 13/16	4⅝
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 15	13 — 15	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	13 — 14	13 — 15	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	6 %	4⅞— 5¼xd	5 — 5¼	5⅛	5 1/16
2,000,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	97 —100	98 —101	100	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅞— 1⅛	⅞— 1⅛	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	...	...	100 —103	100 —103	...	...
11,839	Reuter's	8	5 %	5 %	5 %	7½— 8½	7½— 8½	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	125 —130	125 —130	...	...
58,000	United River Plate Telephone	5	5 %	6 %	7 %	4⅜— 5¼	4⅜— 5¼	...	...
16,639	Do. do. 5 % Cum. pref. Nos. 1—16,639	5	...	...	...	4⅜— 5¼	4⅜— 5¼	...	...
179,947	Do. do. 5 % Debs.	Stock	...	...	...	104 —107	104 —107	...	...
200,000£	West African Telegraph, 5 % Debs.	100	...	...	...	98 —101	96 — 99 xd	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	...	...
150,000	Do. do. 4 % Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	99 —102	99 —102	...	...
389,731	Western and Brazilian Telegraph 4 % Deb. Stock Red.	Stock	...	...	...	... — ...	... — ...	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	...	14⅜—15¼ xd	14⅜— 15¼	15⅛	14⅞
75,000	Do. do. 5 % Debs. 2nd series, 1906	100	...	...	...	103 —106	103 —106	...	...
88,321	West India and Panama Telegraph	10	⅜%	2 %	⅝%	⅝— ⅞	⅝— ⅞	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	...	...	6½— 7½	6½— 7½	7	...
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	...	...	5 — 6	5 — 6	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	...	...	102 —105	103 —106	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	4 %	6 %	6 %	7 — 8	7 — 8	...	...
12,000	Do. do. 7 % Cum. Pref.	5	7 %	...	...	8½— 9½	8½— 9½	...	...
50,000	Charing Cross and Strand Electricity Supply	5	7 %	8 %	9 %	9 — 10	9 — 10	9¼	...
20,000	Do. do. do. do. 4½% Cum. Pref.	5	...	...	...	5¼— 5⅝	5¼— 5⅝	...	...
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	6 %	6 %	6½— 7½	6½— 7½	...	...
150,000	Do. do. do. % Deb. Stock Red.	Stock	4½%	...	...	108 —111	108 —111	...	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000	10	10 %	6 %	4 %	7½— 8½	7½— 8½	...	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	12 — 13	12 — 13	12 9/16	12¼
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	...	...	123 —128	123 —128	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	*nil*	*nil*	4 %	8½— 9½	8½— 9½	8⅝	8 9/16
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	...	11 — 12	11 — 12	...	...
200,000	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd.	...	...	...	...	107 —110	107 —110	109	108½
26,100	Edmundson's Elec. Corp., Ord. Shares	5	5 %	7 %	...	4½— 5	4½— 5	...	...
75,000	Do. do. 4½ % 1st Mort. Deb. Stock.	100	...	...	...	99 —102	99 —102	...	...
110,000	London Electric Supply Corporation, Limited, Ord.	3	...	...	...	1 — 1½	1 — 1½	...	...
49,840	Do. do. do. do. 6 % Pref.	5	...	6 %	...	3½— 4½	3½— 4½	4⅛	...
250,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	99 —101	99 —101	...	...
85,000	Metropolitan Electric Supply, 101 to 62,500	10	6 %	5 %	5 %	14 — 15	14 — 15	14⅞	...
220,000£	Do. 4½% First Mortgage Debenture Stock	...	4½%	...	...	111 —114	111 —114	...	...
220,000	Do. 3½% Mort. Deb. Stock Red.	Stock	...	...	...	96 — 98	96 — 98	97½	97¼
6,452	Notting Hill Electric Lighting	10	6 %	6 %	7 %	14½— 15½	14½— 15½	...	...
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14 — 15 xd	14 — 15	14 9/16	14½
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8 — 9 xd	8 — 9	...	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	2 — 2½	2 — 2½	...	...
50,000	Do. do. 4 % Deb.	100	...	...	...	85 — 95 xd	85 — 95	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	3 — 4	3 — 4	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000	5	12 %	12 %	13 %	12 — 13	12 — 13	12⅛	12¼

* Subject to Founders Shares.
‡ Unless otherwise stated all shares are fully paid.
Quotations on Liverpool Stock Exchange.
§ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1897.	1898.	1899.	Closing Quotation Aug. 29th.	Closing Quotation Sept. 5th.	Business done week ended Sept. 5th, 1900. Hig hest	Lowest.
		‡							
65,000	Aluminium shares, Nos. 1—65,000	1	10 %	20 %	...	2¾— 3	2¾— 3	...	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	96 —101	96 —101	...	...
30,000	British Electric Traction	10	...	6 %	...	14½— 15½	14½— 15½	15	...
50,000	Do. do. 6 % Cum. Pref.	10	...	...	...	12 — 13	12 — 13	12 13/16	12⅝
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	123 —126	123 —126	...	...
85,000*l*	†British Electric Works Co., Ord. £1 shares, 50,001—135,000	...	...	...	...	⅜— ½	⅜— ½	...	...
50,000	† Do do. 6 % Cum.Pref., 1—50,000 ...	...	...	...	...	¾— ⅞	¾— ⅞	...	...
500	† Do. do. 4½ % 1st Mort. Deb.	100	...	...	...	97 — 99	97 — 99	...	...
40,000	British Insulated Wire Ord., Nos. 1 to 40,000	5	15 %	15 %	20 %	11½— 12½xd	11 — 12	...	...
27,500	Do. do. 6 % Cum. Pref. Nos. 1 to 27,000 ...	5	...	...	...	5¾— 6¼xd	5¾— 6¼	...	...
90,000	Brush Elecl.-Enging., Ord., 1 to 90,000	3	3 %	5 %	...	1⅝— 1⅞	1⅝— 1⅞	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000 ...	2	6 %	6 %	...	2½— 2⅝	2⅝— 2⅝xd	2 5/16	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	108 —113	106 —111 xd	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red	Stock	...	...	...	101 —103	101 —103	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	12½%	15 %	15 %	13 — 14	12½— 13½	12⅝	...
20,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5¼— 5⅝	5¼— 5⅝	...	...
90,000	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	S ock	...	...	...	110 —114	110 —114	...	...
213,533	Central London Railway, Ord. Shares	10	...	...	...	9⅝— 10¼	10 — 10½	10⅜	9 13/16
61,033	Do. do. Pref. half-shares	5	...	...	...	4⅜— 5¼	4⅜— 5¼	...	...
71,447	Do. do. Def. do.	5	...	...	...	4⅜— 5¼	4⅜— 5¼	5 3/16	5
855,000	City and South London Railway	Stock	1½%	2½%	1½%	57 — 60	57 — 60	...	...
37,500	Do. do. Ord. shares Nos. 22,501 to 60,000	10	...	...	...	5 — 6	5 — 6	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	6 %	7½%	3¾— 4¼	3¾— 4¼	...	...
100,000	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	99 —102	99 —102	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	6 %	6 %	1¾— 2¼	1¾— 2¼	2	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	6 %	6 %	3½— 4½	3½— 4½	...	...
344,023	Do. do. do. 4 % Deb. Stock Red ...	100	...	...	...	89 — 91	90 — 92	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	1⅞— 2⅛	1⅞— 2⅛	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000... ...	2	7 %	7 %	...	2⅜— 3¼xd	2⅜— 3¼	...	...
140,300	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	102 —105	102 —105	103½	102½
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600	10	7 %	7 %	7 %	10 — 11	10 — 11	...	...
30,000	Henley's (W. T.) Telegraph Works, Ord.	5	12 %	14 %	15 %	12½— 13½	11½— 12½	12	...
30,000	Do. do. do. 4½ % Pref.	5	7 %	7 %	...	5 — 5½	5 — 5½	5¼	5 3/16
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½%	...	...	110 —114	108 —112 xd	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	21 — 22	21 — 22	...	...
300,000	Do. do. do. 4 % 1st Mort. Deb	100	...	...	...	101 —104	101 —104	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3½%	3½%	3⅜%	8⅞— 9	8⅜— 9	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	13 — 13¼	12⅜— 13¼	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	35 — 39xd	35 — 39	...	...
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	101 —104	101 — 104	...	...
20,000	Telegraph Manufacturing, Ord. Nos. 1 to 20,000	5	...	8 %	12 %	10⅜— 11⅛	10½— 11½	...	...
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000...	5	...	...	...	5¼— 5⅜	5¼— 5⅜	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	3 %	3 %	91 — 94	92 — 95	...	...

† Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8—10.
Brompton and Kensington, 4½ % Debentures of £100, 103—105.
National Electric Free Wiring, 12/6 paid, ⅜—½.
Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 17—18 xd.
Do. do. Pref. (£10 pd.), 10—10¼ xd.

* From Birmingham Share List.

Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12—13; 1st Preference Cumulative 6 % £5 (fully paid), 6¾—7¼. Debentures, 102—105. Dividend, 1899, on Ordinary Shares 11 %.
*T. Parker, £10 (fully paid), 17¾.

Bank rate of discount 4 per cent. (July 19th. 1900).

MARKET QUOTATIONS, Wednesday, September 5th.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a ,, Nitric	per cwt.	22/-	22/-	..
a ,, Oxalic	per cwt.	32/-	32/-	..
a ,, Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	39/-	39/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33	£33	..
a ,, ,, ..	per ton	£30	£30	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£17	£17	..
a Bensole (90 %)	per gal.	7/-	7/-	..
a ,, (50/90%)..	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£25 10	£25 10	..
a Lead, Nitrate	per ton	£25	£25	..
a ,, White Sugar	per ton	£31	£31	..
a ,, Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	3¾d.	3¾d.	..
a ,, Caustic (75/80%) ..	per ton	£24	£24	..
a ,, Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	68/-	68/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6	£6	..
a ,, Recovered	per ton	£5 10	£5 10	..
a ,, Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	£10 15	..
a ,, Crystals	per ton	£3	£3	..
a ,, Bichromate, casks ..	per lb.	2¾d.	2¾d.	..

METALS, &c.				
b Aluminium Wire, in ton lots..	per ton	£224	£224	..
b ,, Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal ingots.. ..	per ton	£80 to 150	£80 to £150	..
c Brass (rolled metal 2" to 12") basis	per lb.	7¾d.	7¾d.	..
c ,, Tube (brazed)	per lb.	10d.	10d.	..
c ,, ,, (solid drawn) ..	per lb.	8¼d.	8¼d.	..
c ,, Wire, basis	per lb.	8¼d.	8¼d.	..
c Copper Tubes (brazed) ..	per lb.	11¼d.	11¼d.	..
c ,, ,, (solid drawn) ..	per lb.	11d.	11d.	..
g Copper Bars (best selected) ..	per ton	£85	£85	..

METALS, &c. *(continued.)*		This week.	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£85	£85	..
g ,, Rod	per ton	£85	£85	..
e ,, (Electrolytic) Bars ..	per ton	£83 10	£83 10	..
e ,, ,, Sheets ..	per ton	£92	£92	..
e ,, ,, Rod ..	per ton	£85 10	£85 10	..
e ,, ,, H.C. Wire	per lb.	9¾d.	9¾d.	..
f Ebonite Rod	per lb.	3/-	3/-	..
f ,, Sheet	per lb.	5/-	5/-	..
n German Silver Wire	per lb.	1/6	1/6	..
h Gutta-percha fine	per lb.	8/6	8/6	..
h India-rubber, Para fine	per lb.	3/11½ to 4/2½	3/11½ to 4/2½	..
i Iron, Charcoal Sheets	per ton	£18	£18	..
i ,, Pig (Cleveland warrants) ..	per ton	71/9	71/9	..
i ,, Forgings, according to size	per ton	From £11	From £11	..
i ,, Scrap, heavy	per ton	70/- to 72/6	70/- to 72/6	..
i ,, Wire, galvanised No. 8 ..	per ton	£12 15	£12 15	..
g Lead, English Ingot	per ton	£17 17 6 to £18	£17 15 to £18	..
g ,, ,, Sheet	per ton	£19	£19	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bot.	£9 5	£9 5	..
d Mica (in original cases), small ..	per lb.	9d. to 9d.	9d. to 9d.	..
d ,, ,, ,, medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d ,, ,, ,, large ..	per lb.	3/3 to 7/3	3/3 to 7/3	..
p Phosphor Bronze, plain castings	per lb.	1/1 to 1/4	1/1 to 1/4	..
p ,, rolled bars & rods	per lb.	1/1 to 1/4	1/1 to 1/4	..
p ,, ,, strip & sheet	per lb.	From 1/3	From 1/3	..
o Platinum	per oz.	£3 13 6	£3 13 6	..
p Silicon Bronze Wire	per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, ace'd'ng to desc'p'n	per ton	From £15 to £40	From £15 to £40	..
i ,, ,, in bars		£58	£58	..
g Tin, block	per ton	£140 to £141	£137 to £139	£3 inc.
g ,, foil	per lb.	2/-	2/-	..
n ,, wire, Nos. 1 to 16	per lb.	1/9	1/9	..
p White Anti-friction Metals —				
"White Ant" brand	per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10 lb b'ndl's	per lb.	8½d.	8½d.	..
j ,, Best Flax, 6 lea.	per lb.	6d.	6d.	..
j ,, Hemp, 3 ply 10 lbs. ..	per lb.	4½d.	4½d.	..
j ,, ,, Russian, 10 lbs. ..	per lb.	5½d.	5½d.	..
j ,, Jute, 180 lbs. rove ..	per ton	£14 10	£14 10	..
k Zinc, Sh's't. (Vielle Montagne ord.)	per ton	£24 5 nett.	£24 5 nett	..

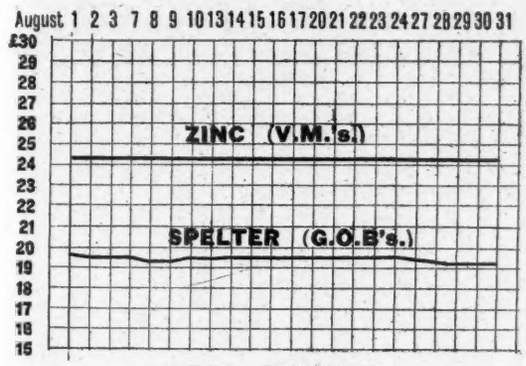
Quotations supplied by { a Messrs. G. Boor & Co. b The British Aluminium Co., Ltd. c Messrs. Thos. Bolton & Sons. d Messrs. F. Wiggins & Sons. e Messrs. Frederick Smith & Co.

Quotations supplied by { f India-Rubber, G.-P. and Teleg. Works g Messrs. James & Shakspeare. [Co., Ltd. h Messrs. Jackson & Till. i Messrs. Bolling & Lowe. j Messrs. Henry C. Yeo & Co.

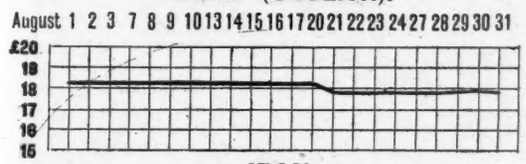
Quotations supplied by { k Messrs. Morris Ashby, Limited. m Messrs. W. T. Glover & Co., Ltd. n Messrs. P. Ormiston & Sons. o Messrs. Johnson, Matthey & Co., Ltd. p The Phosphor Bronze Company, Ltd.

Dividends marked ‡ are for a year consisting of the latter part of one year and the first part of the next.

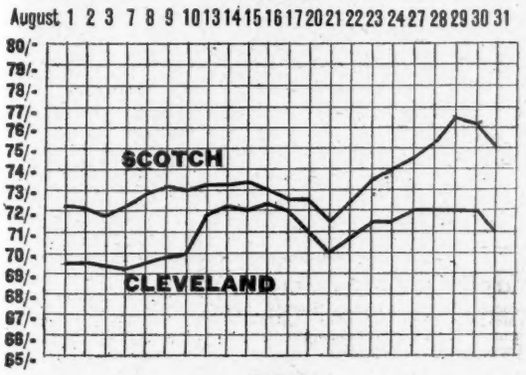
METAL MARKET.—Fluctuations in August.



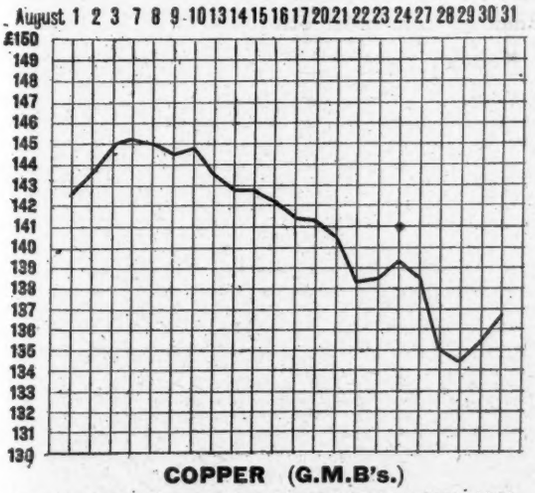
LEAD (ENGLISH).



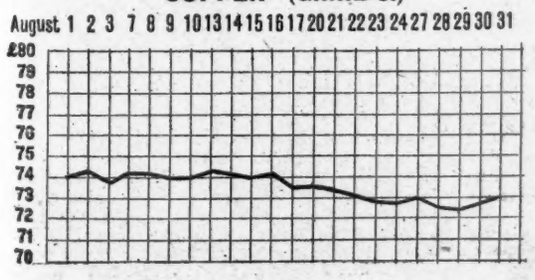
IRON.



TIN.



COPPER (G.M.B's.)



WHY SOME MUNICIPAL ELECTRICAL PLANTS DO NOT PAY BETTER.*

We take the following extracts from a paper read before the North-Western Electrical Association at its Waupaca meeting, June 28th, by Prof. George D. Shepardson, of the University of Minnesota. The author has in mind electric light and power stations, but the same things that he finds to be true of them would also apply to municipal railways:—

The subject of municipal ownership has been discussed at almost every session of this Association, and the general sentiment seems to be that the principal cause of the agitation in favour of municipal ownership is the circulation of incorrect figures as to the real cost of operating existing municipal plants. It is easy to see why the reports of such cost are almost invariably too low. The towns almost never know the real cost of the light, on account of faulty records. Each town desires to make the best showing possible, for when a low figure is quoted, the general public immediately concludes that it is enterprising, while those who know how such reports are compiled, smile at their ignorance of the real cost. The other principal cause is the general belief on the part of the public that the electric companies are making enormous profits, whereas the painful fact is that probably few of the smaller companies at least are really earning any dividends. In towns of less than 2,000 or 3,000 inhabitants, it is a very difficult matter for an electric light station to earn respectable dividends unless it is operated in conjunction with some other business, for example, a mill, so that the labour and administrative expenses are reduced to a minimum. Similar conditions hold in many plants in larger towns. The reports of some stations show larger profits than actually exist, which, while flattering to stockholders, are yet deceptive, if not positively harmful. A uniform method of keeping accounts, such as is being urged by the National Electric Light Association, would do much to help station managers to discover their own real situation. Did the municipal private plants have correct methods of keeping records, so that it was generally known how much it actually costs to operate municipal plants, and how small the net earnings of private plants really are, the agitation would probably die a natural death in a few years. As a matter of fact, the managers of some of the largest central stations advocate the public supervision of their accounts, that the actual facts may be in the possession of the people. The ordinary citizen reads the report that the operating expenses of a large plant are only 50 per cent. of the gross income, and he believes that the remaining 50 per cent. is clear profit, forgetting about the numerous charges which reduce this to 15 or 5 per cent. He also compares the cost of a KW.-hour produced at the station with that charged on his bill for service, and then firmly believes that the company is making from 100 to 2,000 per cent. clear profit. The public generally have no objection if a reasonable dividend is earned, but there is objection to what are felt to be enormous profits.

The result of the agitation for municipal ownership of electric plants was shown in the statistics for Minnesota; in 1894 the central station directories showed 10 municipal and 38 private electric lighting plants, while in 1900 there were 53 municipal and 63 company plants.

Of the data on costs it is said:—The reports of the low rates with municipal plants are due to several causes, usually to ignorance of the real cost. Expenses that should be charged against the electric plant are often placed against the waterworks or against the general fund, and are often ignored until it becomes necessary to pay some bonds. Depreciation is often not considered, and when something finally gives out, a special appropriation is made for renewals, and is charged against something other than the operating expenses of the municipal lighting plant. The result is that the rates received for electric light are often considerably below actual cost to the town, and the saving to the people who take electric light is made up by increased taxation of the whole people. If the town sells electric light below cost, it should in all reason furnish kerosene and candles at proportionally low figures. And why not groceries and dry goods likewise?

After a *résumé* of the arguments for and against municipal ownership, there are given some incidents (from personal knowledge and the contributions of friends whose testimony is believed to be reliable) showing why the efficiency in municipal plants is less than called for by the theories of some political economists.

At one place they decided to secure a cheap engineer to design their plant. He specified a 20-H.P. gasoline engine to operate a 600-light dynamo, and, in addition, to drive the pumping machinery for the waterworks. The Council made a contract for the gasoline engine as specified, including a proviso that if a steam plant was substituted, the gas engine contractor was to receive a commission of 15 per cent. of the cost of steam plant. It is reported that this was actually done and paid. Two of the larger towns of the State were contemplating municipal ownership, and each secured the services of an inexperienced young man to prepare plans and specifications for the plants, in one case because he was a friend or relative of one of the committee, in the other case, probably, because he was cheap. The country is full of half-baked electricians who pose as engineers and as advisers to investors.

There is frequently an attempt to reduce operating expenses too far. At one place the Council discharged a good engineer and hired another because he was cheap. Within three days he got his cylinder full of water and broke the girder of the Corliss engine. It is common, even with privately-owned stations, to attempt economy by hiring cheap firemen, since anyone can shovel coal or throw wood. But owners fail to recognise that by paying $10 to

* *Street Railway Review*, Chicago.

Quotations supplied by
b The British Aluminium Co., Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons.
e Messrs. Frederick Smith & Co.

Quotations supplied by
g Messrs. James & Shakspeare. [Co., Ltd.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yeo & Co.

Quotations supplied by
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

$20 more for securing a capable fireman they are apt to save his extra wages several times over in reduced fuel bills.

In some cases there is great loss on account of downright dishonesty of the superintendent or the council committee. A city employing an honest superintendent, with liberal pay and some backing in the council, will often prevent small and also large steals which are almost invariably found in municipal departments, such as lamp renewals (on which it is difficult to keep accurate account or check), "rake-offs" on purchases for the plant for which in the end the city pays. One supply company offered a new superintendent as high as 20 per cent. on all purchases the year round, as they had always done so. This is substantiated by old bills. Lamps are checked up once a month while burning, and one is often asked to go easy in counting, being offered all sorts of bribes, from cigars or drinks to considerable sums in cash. I know of officials receiving special concessions in this way amounting to several hundred dollars per year. All this could have been prevented by a proper system of checking, but at best it comes down to one man being honest. "Car loads of wood have been sold 'by the car' by former superintendents. An investigation by an alderman indicated that a loss of over $1,000 per year had been received from that source alone." In another place the city recorder is said to collect the accounts, and sometimes sublets the job to his friends who knock down about half and turn the balance over to the recorder, who in turn transmits to the treasurer so much of it as suits his convenience, there being no records and no other system.

The political conditions prevent best results in many plants. Where the employés are appointed by aldermanic influence, it is not uncommon for an underling to retort to his superior officer when corrected for some shortcoming, "Oh, well, I have more pull than you have, and what are you going to do about it?" In one town, until recently, the plant was operated by two parties, an engineer, who took care of the station, and a lineman in charge of outside work. These parties were not on speaking terms, and, of course, each attributed all troubles with the lights to the other man's part of the plant. This state of affairs continued for several years, during which time the arc system was in bad condition, the lineman attributing it to the dynamo, and the engineer laying it to the lamps. When a change was made, there were two applicants for lineman, one a young man who would have attended to business, the other a young son of one of the aldermen and with little experience or ability. There were also two applicants for fireman, one a good man, and the other a lazy, good-for-nothing fellow, who claimed to have considerable influence in the country, so that he could turn considerable trade to some of the stores in which the aldermen were interested. By combining forces the poorer man was appointed in each case. There is a continual struggle between the temperance and the saloon element in most of the towns, and when a new election puts the opposition into power, the superintendent is almost sure to lose his place in favour of some friend of the new management.

STEEL: ITS PROPERTIES AND TESTS.

I.

Some useful information may be gathered from Mr. A. L. Colby's review of American standard specifications presented at the International Congress in Paris. It is argued that test methods may be made the subject of international agreement. For this purpose the process of manufacture may properly be stipulated; the limits of certain constituents are fairly to be stated, especially those of sulphur and phosphorus, and the physical properties may be named, but details of the process of manufacture are not admissible. Shape, number, and location of origin of test prices may be specified, and the manner of testing such specimens both physically and chemically.

Ten standard specifications are given, as framed by the American section of the International Association. As these include articles and material in common use by electrical engineers, we propose from time to time to give abstracts from each. American practice in steel employs the crucible process but little for tires, forgings or castings, the total make in 1899 being only 3,500 tons. This differs from English practice, though we have no figures before us of English turnout, but firms like Hadfields, Jessops and others make a large output of crucible steel. Bessemer steel is used for rails and structural work, also for axles, forgings and castings. American Bessemer steel is all made by the acid process, none of the three basic plants being now at work. Practically, all American rails are of Bessemer steel, of which 2,270,000 tons were made in 1899; but only 3,939 tons of castings were made.

Open hearth steel is allowed in all the nine standard specifications, and it alone is specified for boiler plate and rivet steel, bridge and ship steel, and steel axles. In this steel no distinction is made between acid and basic steel, except that in bridge and ship steel phosphorus must not exceed 06 per cent., whereas in acid steel it may be 08 per cent. From 1896 to 1899 inclusive, the percentage of basic steel by the open hearth process has grown from 59·8 to 70·6 per cent, the total production in 1899 of both falling but little below 3 million tons metric. It is legitimate for an engineer, who desires to do so, to call for acid steel, but it diminishes the area of supply, and shuts off healthy competition. It is legitimate to demand that annealing shall not include a slow cooling from the initial temperature of casting, rolling, or forging, but it is not the province of the engineer to specify that all steel for wire shall be made in a silica-lined furnace, or entirely of pig iron, all other stock being barred, and so on, even to prohibiting the running of a cast unless the inspector is there. Such specifications defeat their own ends, and simply harry the manufacturer, and increase the cost of production, while it is obviously impossible for even thoroughly experienced inspectors to follow the specification without delaying the progress of work. It is well known that such requirements are ignored. Why then hold to them? Such weak points in specifications being abandoned in the inspection, destroy some of the strength of essential requirements. It is very usual even to withdraw such unwise demands in order to enable an order to be placed. It is considered better to increase the percentage of elongation and contraction than to attempt to specify upon the annealing process.

Turning to chemical requirements, it is observed that no limit of carbon is specified where the tensile strength is specified, except in splice bars, *i.e.*, fish-plates. A manganese limit is properly specified in tires, boiler plate, rivets, rails and fish-plates, while a silicon limit is asked only in tires and rails.

Phosphorus is so dangerous an impurity that its limits may properly be defined in all things, and sulphur in all but rails and structural steel, owing to its red short properties. Copper is given no limit. It is considered to have been now definitely settled that copper in even large quantity is not deleterious.

Campbell asserts that copper may exist up to 1 per cent., but if high sulphur, say 08 to 10 is co-existent, the steel will crack in rolling, especially during the first passes of the ingot, so that it is of little importance to the engineer who is concerned with the finished product, of which the *cold* properties seem to be entirely unaffected. Copper has been alloyed with iron up to 7 per cent. The alloy is hard and cannot be tooled. Generally all evidence is that copper need not be considered.

It may appear odd to omit any reference to carbon where tensile strength is specified, but it is a fact that carbon has been specified in such proportion as to render it impossible to meet the tenacity requirements. Hence where physical properties are defined with clearness the chemistry of steel may be ignored save in prescribing the limits of the really injurious impurities, phosphorus and sulphur.

(*To be continued.*)

OUR LEGAL QUERY COLUMN.

[*Questions addressed to the Editors for insertion in this column should be as brief and concise as possible. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.*]

Changed Over writes:—"Having read the article in your issue of August 24th on 'Change Overs' with great interest, I should be much obliged if you would go further into the question, and give us definite information on the following points:—

"Firstly, supposing that a consumer is taking his supply at 110 volts, and the supply station propose to change him over to a higher pressure, are the supply people bound to give the consumer notice in writing, and to receive his written consent before changing the pressure?

"Secondly, supposing that a consumer has a meter on his premises for which he is paying the supply company an annual rental, and on changing the pressure over the company do not change the meter, but utilise the same 110-volt meter for registering the current at the higher pressure, and on sending the account in multiply the units registered on the meter by two, and charge accordingly for double what the meter has registered, can the consumer legally dispute the account, and is it lawful for the supply people to charge in this way?

"As this matter is just now very interesting, a definite answer would be of great assistance."

*** In answer to the first question addressed to us by "Changed Over," we think that in the absence of a special term in their contract with a consumer, enabling them to supply energy at any pressure they think fit, the supply company would have to give notice of the change suggested. Further, if the company had agreed to supply electricity at a definite pressure—and the terms and conditions of supply usually contain a definite statement of the proposed pressure—it would be a distinct breach of contract on their part to make a change which might involve considerable expense to the consumer. A consumer is entitled to insist on being supplied with electricity on the same terms as others are supplied in the district (45 and 46 V., c. 56, Section 19), and also to insist on being supplied in accordance with the terms of the Board of Trade regulations. If undertakers make default in these respects they become liable to penalties prescribed by the Board of Trade, but, in addition to these compulsory requirements, the undertakers are bound to fulfil their contract with their consumers—and if need be they must defray any expense to which he may be put by alteration of pressure.

With regard to the second question put by "Changed Over," it would seem that so long as the meter registers correctly the amount of electricity consumed, the customer cannot complain. The accuracy of the meter is left to the electric inspector to determine, and his decision is final. The register of the meter is *prima facie* evidence of the quantity of electrical energy consumed, and it is usual to insert a clause in the "conditions" to the effect that if it is questioned, an official examination will be made. If the official test shows that

* *Street Railway Review*, Chicago.

the meter registers incorrectly, the undertakers generally pay the fee, and make adjustment for the period in dispute. If the meter is declared correct, the consumer pays the fee. Assuming, therefore, that the correct amount can be arrived at by "multiplying by two," we see no reason why the consumer should object. Should that method prove inaccurate, it is clear that the consumer could add the expense of providing a new meter to his bill when rendering an account of the expense to which he has been put by increased pressure.

"Metal Worker" writes:—"Will you kindly inform us (to settle a dispute) whether a private firm having two business places may run a telephone from one to the other, crossing several roads in its way, without infringing the rights of the Post Office, telephone companies, &c.? The argument is about a private wire used by no one but the firm which owns it."

*** The difficult question put by our correspondent has not, so far as we are aware at present, been definitely decided in any case. That telegraphs and telephones are a monopoly of the Postmaster-General is undoubted; that no one is allowed to work a telegraph or telephone for profit without a license is undeniable; but a wire used solely by a private firm seems to come under a different category. Our own view at present is that, assuming the road authorities make no objection to the telephone wires crossing the streets, the firm may safely erect the telephone. We say this in the absence of authority upon the point. Pressure upon our space prevents us from dealing with this question at greater length at present, but we hope in a subsequent issue to deal further with this matter, and if compelled by more careful research to modify the view above expressed.

CURRENT SPECIFICATIONS.

XXVII.—HORTON ESTATE ASYLUM.—LONDON COUNTY COUNCIL.

SUMMARY.

Scope of Contract.—Complete equipment of power house for the electric lighting of Horton Estate Asylum.

Number and Type of Boilers.—Three to be supplied of Lancashire or other approved type, each capable of supplying steam to a 150-KW. steam dynamo.

Working Pressure.—160 lbs. per square inch.

Fuel Economiser.—A fuel economiser of approved make and ample size to be supplied, arranged in two groups.

Ash Hoist.—One to be provided, either electric or hydraulic, suitable for a working load of 15 cwt.

Travelling Crane.—One to be fitted, worked by hand power, suitable for lifting heaviest parts of steam dynamos.

Pipework.—To be supplied and fitted under contract.

Number of Steam Dynamos.—Three to be supplied, each capable of developing 150 KW. as normal working load.

Type of Engines.—To be of compound expansion, condensing enclosed type, to run at speed of not more than 300 revolutions per minute.

Normal Voltage of Dynamos.—400 volts.

Foundations.—The necessary foundations for the whole of the plant must be included in the contract sum.

Condensing Plant.—To be of the "jet" type complete with necessary air and circulating water pumps.

Motor Boosters.—Two to be supplied, each consisting of motor and booster. The two sets to be mounted on same foundation, and connected together through flexible coupling.

Output of Boosters.—Each to be capable of developing 12 KW. (150 amperes) at any voltage between 10 and 80 volts.

Output of Balancers.—The motors for driving boosters to be of ample size, and to be suitable for use if required as balancers on a three-wire 200-volt system.

Speed of Combination.—Not to exceed 1,000 revolutions per minute.

Capacity of Battery.—To consist of 245 cells, each having a capacity of 800 ampere-hours when discharged in four hours. Terminal E.M.F. of cell at end of discharge to be not less than 1·86 volts.

Switchboard.—A main switchboard to fulfil specified requirements to be supplied and fixed.

Motors.—Four motors (two of 20-H.P. size, one of 6-H.P., and one of 2-H.P.) of ironclad type, with all necessary resistance, to be supplied.

Lighting of Power Station.—Seventy-eight lamps as specified, to be wired for and supplied.

Specified Date of Completion.—Not to exceed 12 months, part in seven months.

Penalty for Late Completion.—£10 per week.

Terms of Payment.—80 per cent. of value of "permanent work properly executed and fixed on site;" 10 per cent. one month after completion; 10 per cent. at end of 12 months' period of maintenance.

Stipulations as to Removal of Foreman.—Satisfactory.

Stipulations as to Wages paid to Workmen.—Very unsatisfactory—see comments below.

Arbitration Proposals.—Very unsatisfactory—see below.

Date on which Tenders are Due.—September 22nd, 1900.

This specification provides for the equipment of the electric power house at the Horton Estate Asylum, Epsom. The work is to be done to the order of the Asylums Committee of the London County Council, and in accordance with the general conditions adopted by that authority for use in all engineering contracts.

The technical requirements are clearly stated, a wise latitude being left to the tenderer as to the exact outputs of the plant to be supplied. There ought to be no difficulty in complying with the requirements, using, to a very large extent, ordinary standard apparatus. Great care has been taken to specify the positions and the method of wiring to be adopted for the 78 glow lamps which will be used for lighting the power house and adjoining buildings. We also notice that in specifying the output of the accumulators the capacity is stated as 800 ampere-hours when discharged at the two rates of 100 and 200 amperes. In practice, if the required capacity is obtained at the higher rate of discharge, it will be considerably increased when the rate of discharge is reduced to one-half. It is stipulated that generating plant to a capacity of about 50 KW. shall be available for use in *seven* months from date of order, and that the whole of the work shall be completed in an additional *five* months under a penalty of *£10* per week.

This is the first time we have had the opportunity in this series of articles of criticising the general conditions to engineering contracts insisted upon by the London County Council.

There may be a difference of opinion as to the motives which have led to the adoption of these and similar clauses by that body, we think there can be none as to their unjust character. It would be easy to demonstrate, that in their operation conditions such as these are prejudicial to contractors, artisans, purchasers, and ratepayers alike, but in the space at our disposal we can only draw attention to those clauses which directly affect the manufacturer preparing a tender for the work.

The clause headed "arbitration clause" reads as follows:—

If *any difference or dispute shall arise between the committee and the contractor*, either with regard to the construction or effect of the contract, or to the rights, duties, or liabilities of the contractor or the committee under the contract, or as to the due performance of the contract by the contractor, or as to any materials or workmanship, or as to any other matter or thing or cause of difference arising out of the contract or the execution thereof directly or indirectly, *the same shall be referred to the award and decision of the engineer as sole arbitrator, whose decision shall be final and conclusive between the parties*, and the provisions of the Arbitration Act, 1889, shall apply to any arbitration under this clause.

It would be fairer to style this "*denial of arbitration clause*," for it denies to the contractor any chance of stating his case before an *impartial* authority. When, as in this case, the engineer is both counsel for one party and judge it cannot be termed an *impartial* or *just* tribunal, and counsel for one party he may undoubtedly be termed to be, when he is the paid servant of that party, and responsible to it, not only for the preparation of the specification, but also for its due fulfilment by the other party. These remarks are made quite irrespective of the person acting as engineer to the Council; however hard he may try to give absolutely impartial decisions, and however just may be his verdicts, his rulings will always be open to the feeling of distrust inseparable from his dual position, and we contend that it is exceedingly unfair of the Council to place any of its servants in this unenviable position. Throughout the whole of the clause there is a painful reiteration of the demand that the decision of the engineer shall be final; thus, in referring to possible discrepancies in the specification, we find:—

The specification contained in the first and second schedules hereto and the said plans are to be considered as explanatory of each other, and should anything appear in any one that is not described in the other or others, no advantage shall be taken by the contractor of any such omission. Should any discrepancy appear between this contract and the said specification and the said plans, or between any two of them, or between different parts of any one of such documents, or should any misunderstanding arise as to the meaning or import of this contract, or the said plans or any of them, or as to which of them shall be followed, or about the quality or dimensions of the works, machinery, plant, fittings, matters or things to be supplied, or the due and proper execution of the said work, or as to the measurement, quality, or valuation of the works, machinery, plant, fittings, matters and things provided or executed under this contract, or as extras upon this contract, or as to any additions to or deductions from the contract price, or as to any other matter or thing whatsoever arising out of or in relation to this contract, *the same shall be explained and decided by the engineer, and his*

explanation and decision shall be final and binding upon the contractor and the committee, and *the contractor shall execute the said works according to such explanation and decision.*

In the same way the engineer is sole judge as to the quality of all work done under the contract, the one whose decision on all variations of price for extra work done or work omitted is finally binding, and whose will as to the time at which the work is to be done must be obeyed. We do not say that a contractor under these conditions would necessarily suffer unjust treatment in these directions, but the wording of the clauses certainly confers excessive and unjustifiable powers upon the engineer, of which very arbitrary use might be made without in any way violating the letter of his instructions.

This power to vary work may prove very unfair. As worded the clause gives absolute power, it says :—

The engineer may also alter or vary any of the said works, or may order any of the said works to be omitted with or without the substitution of any other works in lieu thereof, or may order any work or any portion of work executed or partially executed to be removed, changed, or altered, or may order additional works to be executed, and the difference of expense to be occasioned by any alteration, variation, omission, or addition as aforesaid shall be added to or deducted from the contract price as the case may require, and the amount of such addition or deduction shall be ascertained and determined by the engineer in accordance with such rates or prices as shall be determined by the engineer as fair and reasonable.

Suppose that half of the work specified is thus dispensed with. Many of the risks the contractor has to provide for remain practically stationary ; his profit, if any, is halved, and he has no *locus standi* or right to ask from any impartial authority compensation for the actual work done being so much less than that on which his estimates of cost were based.

We strongly urge all tenderers not only to stipulate for an unlimited arbitration clause, but also to limit to a certain percentage of the total contract sum the extent to which the work done under the contract may be reduced from the amount now asked for.

Clause 22 needs careful reading ; it states :—

The contractor shall take every proper precaution to prevent any accident or injury to any person or body, or to any property or works (whether belonging to or under the control of the Committee or the Council or others) from any cause whatsoever arising out of or in connection with the execution of the said works, and shall forthwith, on any such accident or injury occurring, repair, make good and defray any loss, damage, cost, charge or expense arising thereby or therefrom, or in consequence thereof, to the Committee or the Council or any other person or body injuriously affected, and shall indemnify and save harmless and keep indemnified the Committee and the Council and their respective officers and servants from and against the same, and from and against all actions, suits, claims, penalties, liabilities, costs, expenses and demands whatsoever by reason or on account thereof. *And the Committee or the Council may, if they shall see fit, compromise or settle any such action, suit or other proceeding or claim as aforesaid on such terms as they shall see fit, and the contractor shall thereupon forthwith, on demand, pay to the Committee or Council the sum or sums paid by them, or either of them, upon the occasion thereof, and shall in every case pay to them respectively such sum or sums as shall fully indemnify them from all loss or injury.* All expenses claimed or recoverable or recovered by any local authority against either the contractor or the Council or the Committee in respect of any extraordinary traffic over public roads or highways caused by or arising out of the execution by the contractor of the said works shall be paid by the contractor, and the contractor shall fully indemnify the Council and the Committee from the payment of any such expenses and from all actions, proceedings, liabilities, costs and expenses relating thereto.

While admitting the liability of the contractor to compensate persons injured through his or his servant's negligence, we protest against the demand of the Council that they may, quite irrespective of the contractor, and from the wording of the clause without the necessity of even informing him as to what they are doing, compromise or settle an action to assess damages in any way they think fit, and then call upon him to pay all incurred costs and damages. Surely if the contractor has to pay he should have a voice in the settlement. The clause as worded is unjust, and we advise that strong exception be taken to its provisions by all tenderers.

The labour conditions of the Council are usually considered the high-water mark of municipal Socialism. They contain provisions which render it almost impossible for some of the most reputable firms in the engineering industry to even offer to do work for the Council, and in many ways they react in a most unfavourable manner upon the ratepayer, *i.e.*, largely upon the artizan class themselves.

The principal clauses read as follows :—

The contractor shall at all times during the continuance of this contract abide by, perform, observe, fulfil and keep all and singular the stipulations following, that is to say :—

1. The contractor shall pay all workmen (except a reasonable number of his legally-bound apprentices) employed by him in and about the execution of this contract or any part thereof, wages and wages for overtime respectively, at rates not less than the rates stated in the Third Schedule hereto, and for each and every breach by the contractor of this stipulation, and notwithstanding the condonation of any prior or other breach, the contractor shall on demand pay to the committee as liquidated damages, and not as a penalty, the sum of £5.

2. The contractor shall observe and cause to be observed by all such workmen hours of labour not greater than the hours of labour stated in the said Third Schedule, and for each and every breach by the contractor of this stipulation, and notwithstanding the condonation of any prior or other breach, the contractor shall on demand pay to the committee as liquidated damages, and not as a penalty, for each day on which such breach shall be committed, and each workman in respect to whom it shall be committed the sum of 5s. (five shillings) per hour for every hour during which on each day each such workman shall be employed by the contractor beyond the maximum number of hours stated in the said Third Schedule, provided that this stipulation shall not be construed to prohibit overtime, if such overtime be in accordance with the rules of the trade unions concerned.

3. The contractor shall at all times during the continuance of this contract display and keep displayed upon the site of the works and in every factory, workshop, or place occupied or used by the contractor in or about the execution of this contract, in a position in which the same may be easily read by all workmen employed by the contractor in or about the execution of this contract, a clearly printed or written copy of the said Third Schedule hereto.

4. The contractor shall at any time, and from time to time during the continuance of this contract, whenever called upon so to do by the clerk for the time being of the committee, produce to such officer or officers of the committee as the clerk may direct, the time and wages books and sheets of the contractor in order to show to the satisfaction of such officer or officers whether or not the stipulations contained in this clause have been and are being complied with.

5. Should any workman in the employment of the contractor be not paid the scheduled rate of wages, the committee may pay to any workman who may have been underpaid the difference between the amount of wages which he may have been paid by the contractor and the amount which he would have been paid if the stipulations as to wages had been observed, and may deduct from any moneys due or to become due under the contract the amount of the said difference so paid to such workman.

As regards all work to be done at the Asylum or elsewhere within a radius of 20 *miles measured in a straight line from Charing Cross, in the County of London,* the minimum rate of wages and wages for overtime, and the maximum hours of labour, will be found set out in the list forming Part I. of the said Third Schedule.

As regards all work to be done outside the Asylum and the radius aforesaid, the tenderer must, before delivering his tender, complete the list of rates of wages, wages for overtime, and hours of labour forming Part II. of the said Third Schedule, by specifying the place or places outside the Asylum and radius aforesaid at which any work is proposed to be done, and by filling into the proper columns against each trade specified the rates of wages, wages for overtime, and hours of labour proposed to be paid and observed by the tenderer, which must be those at the date of the tender recognised by associations of employers and trades unions, and in practice obtained in the district in which the work is to be done.

The contract also forbids the contractor to assign or underlet the contract or any part of it, or to sub-contract, except with the consent of the Committee, and upon such conditions as they may think fit ; but if the tenderer at the time of tendering states his desire to sub-let or sub-contract for any portions of the work not usually done by him, the Committee will agree to such sub-letting or sub-contracting to or with an approved person, the principal contractor being responsible to the Committee for the work being done under the same conditions as if done by himself.

Accompanying the specification is the schedule of rates of wages per hour and hours of labour which must be observed if the work is done within the London area, and a blank form asking for similar particulars for work done outside that area. At the moment we say nothing as to whether in our opinion they are excessive or not. They are certainly partial, for they only relate to those of the contractor's employés performing manual labour ; not a word is said as to the conditions under which his clerical or technical staffs should be employed.

We, however, object to the clauses above reprinted *in toto*, and reject altogether the claim that the purchaser of an article has the right to control the relations between the manufacturer and his employés. He may stipulate if he likes that the conditions of employment under which the goods purchased by himself are made shall be fair and reasonable in the opinion of an independent impartial authority, but beyond this he has in our opinion no right to interfere. We strongly advise that no tenderer should agree to the claim of

the Council to dictate the terms of payment, the maximum hours of labour, the rates for overtime, and unless in strict accordance with local Trade Union wishes, to have the power of prohibiting it altogether.

We regard as wholly unjust the demand that the Council should have at all times access to the contractor's private time and wage books, and that they should reserve to themselves the power of heavily fining the contractor for any breach of these regulations of which breach they are themselves to be sole judges. We also protest against the stipulation demanding that the contract rates of payment shall be publicly exhibited in the workshops, as to do this might be the means of fomenting discontent if they in any way differed from the rates usually paid for similar work.

In this contract it is improbable that the principal contractor will himself make more than one-third of the plant, the rest must necessarily be obtained from a large number of other firms who are termed in the general conditions sub-contractors. Under the same heading come also the manufacturers of the materials used by the contractor.

The labour conditions apparently apply to all these manufacturers; and the principal contractor is held responsible to the Council that they are adhered to, or if not he is subject to the penalties above enumerated. We can only say in regard to this that we sincerely pity the successful contractor, who with the knowledge that the general conditions will be strictly enforced tries to place sub-contracts for boilers, engines, condensing plant, &c., &c., with manufacturers of high standing in their respective trades.

No one who carefully reads these labour clauses can fail to note the attitude of antagonism taken up by the Council towards the manufacturer. They appear to be drawn up solely in the supposed interests of labour, else some protection would have been afforded the employer. The contractor is compelled to pay *high* rates, why is not *hard and honest* work demanded from the worker? The contractor is penalised if he evades the regulations, why is there not some mitigation of penalty if he fails through the workman breaking his part of the engagement and by negligence or neglect of duty preventing the contract being completed to time? As they stand the clauses seem to us to be unjust and unworkable in the conditions governing our present day industrial life.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1900.

Compiled expressly for this Journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester and Birmingham, to whom all inquiries should be addressed.

14,868. "Improvements relating to the insulation of electrical conductors." W. A. Phillips and C. E. Kent. Dated August 20th.

14,877. "An improved dynamo-electric machine and regulator therefor." J. Dentel and M. Junka. Dated August 20th.

14,893. "Improvements in electrical measuring instruments." L. B. Atkinson. Dated August 20th.

14,906. "Improvements in or connected with sectional conductor street or road electric railways." J. Milnes. Dated August 21st.

14,915. "A new automatic life-saving guard for electric cars, motor cars, &c. T. Watson. Dated August 21st.

14,924. "Improvements in electric accumulators." H. Rose, J. Halifax and C. H. Antrobus. Dated August 21st.

14,943. "Improvements in switchboards for telephone stations." M. I. Baird. Dated August 21st. (Complete.)

14,971. "Incandescent electric lamps." J. Swinburne. Dated August 22nd.

14,972. "A new or improved arrangement for automatically lubricating the spindles of dynamos." W. G. Graham. Dated August 22nd.

15,001. "Improvements in electric measuring instruments." A. Honig. Dated August 22nd.

15,019. "Improvements relating to the recovery of tin and the simultaneous generation of electric energy." R. H. Gould. Dated August 22nd.

15,021 "Improvements in the manufacture of carbon electrodes for arc lamps." V. Alexandroff. Dated August 22nd.

15,073. "Improvements in electro-plating apparatus," H. R. Boissier. Dated August 23rd. (Complete.)

15,095. "Improvements in electrical demand indicators." The Reason Manufacturing Company, Limited. (A. Wright, High Seas.) Dated August 23rd.

15,123. "A new or improved electrical arc lamp." Nettlefolds, Limited, and W. E. Symons. Dated August 24th.

15,130. "An improved universal direct-acting thermal motor." A. E. Gravier. Dated August 24th.

15,148. "A new or improved electrical hauling apparatus." T. Greensmith and M. B. Wild. Dated August 25th.

15,167. "Improvements in systems of electrical distribution." The British Thomson-Houston Company, Limited. (W. J. Davis, junr., United States.) Dated August 25th. (Complete.)

15,168. "Improvements in commutators for electric machines." The British Thomson-Houston Company, Limited. (J. J. T. Dempster, United States.) Dated August 25th. (Complete.)

15,169. "Improvements in rectifying alternating electric currents." The British Thomson-Houston Company, Limited. (E. Thomson, United States.) Dated August 25th. (Complete.)

15,175. "Improved apparatus for igniting by electricity combustible mixtures in internal combustion motors and the like." A. G. Bloxam. (A. Schoeller, Germany.) Dated August 25th.

15,198. "A new or improved method for adjusting electrodes." R. J. Reynods Dated August 25th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1898.

20,202. "Improvements in electrical apparatus for operating railway points and signals." T. Ducousso. Dated September 23rd, 1898. (Date claimed under Section 103 of Patents, &c., Act, 1883, February 24th, 1898.) Relates to means for electrically actuating railway points and signals. The rod of the point or signal is connected to a slotted lever which is worked by a pin on a disc driven by worm gearing from the motor. This has two oppositely wound field magnets each provided with a line wire to the central station, and an armature connected to the junction of the two field magnet coils and to earth. 8 claims.

20,759. "Improvements in the construction and working of electric arc lamps." La Societe "Les Fils d'Adolphe Mougin." Dated October 1st, 1898. (Date under Patents, &c., Act, 1883, Sec. 103, April 2nd, 1898, being date of application in France.) Relates to arc lamps. A clockwork focussing-lamp for continuous or alternating current is constructed for use with either end uppermost. The frame carries two guide-tubes connected at their ends by a hollow piece. The carbons are carried in sockets on angle-pieces, the upper socket being insulated by washers, and connected with an insulated binding-bolt by a flexible conductor. Each angle-piece is provided with three rollers to run on one guide tube, and with a pin extending through a slot into the tube, and engaging a chain or other flexible connection therein. The chain is endless, and extends over four guide-pulleys at the ends of the tubes, an adjustable tension wheel and a chain wheel secured on an axle rotatable in the lamp frame. A barrel fixed on this axle is attached to the outer end of a coiled spring, the inner end of which is attached to the lamp frame; the spring tends to turn the axle and move the chain so as to bring the carbons together. This motion is controlled by multiplying gearing connecting the barrel with a pin-wheel which is normally stopped by engagement with a projection on a pivoted armature, this being held against a screw stop by a spring coiled in an adjusting drum. The armature is acted on by an electro-magnet connected in parallel with the carbons, allowing the carbons to move together when their difference of potential increases. The feeding spring is wound by the reverse motion of the chain, chain-wheel, axle, and barrel when carbons are inserted, a ratchet and pawl in the gearing permitting such motion. The gearing is carried by a frame movable about the axle by a series electro-magnet acting on the armature; such movement turns the chain wheel and moves the chain to strike an arc. 5 claims.

20,794. "Improvements in electric signalling apparatus for ships." R. von Horvath and M. Cohn. Dated October 3rd, 1898. Relates to electric apparatus for signalling between ships, or between a ship and the shore, during fogs, &c., and may be employed for ships' course signalling. The apparatus comprises a Ruhmkorff inductor and a Righi radiator, which form the transmitter, and a Marconi coherer, which forms the receiver. The circuit of the coherer includes a relay which is adapted to close the circuit of the local battery to actuate an audible or visible signal. The primary circuit of the transmitter and the coherer circuit are closed alternately by the springs, so that the receiver is cut out while a signal is being transmitted, the springs being actuated by the wiper on the shaft, which is driven continuously by the spring or other motor. A signal may also be transmitted independently of the motor by means of the key. The coherer is shaken automatically by the electric beater, the circuit of which is made or broken intermittently by a wheel driven from the motor. The wheel may be cut out by the switch and the beater circuit closed by the key. A series of wipers, each having a different number of arms, may be mounted on the shaft and arranged to complete the primary circuit of the transmitter between any pair of a corresponding series of springs. Switches are provided to enable any desired pair of springs to be connected up to the primary circuit. 5 claims.

20,814. "Improvements in mirrors and in arc lamps for search lights." N. F. D. Barbier. Dated October 3rd, 1898. Reflectors to produce parallel beams are constructed as lenses silvered on their outer surfaces, and optionally made as rings which may be arranged to form continuous inner surfaces. In one form the outer surface is spherical and the inner surface illipsoidal. In others, the inner surface is plane, or spherical. In another modification, rings have plane inner surfaces, which are not at right angles to the axis of the mirror. They may be combined with outer unsilvered catadioptric rings. An arc lamp is described in which each carbon holder is carried by two levers which slide in sleeves carried on axles and have studs in engagement with curved guide-slots by which the carbons are caused to move in a straight line. One of the axles is connected with the armature of a motor. The field magnet of this motor is connected between the supply conductors, and the armature has two opposite windings, either of which may be connected between the mains by a relay, to separate or feed together the carbons. The relay consists of a centrally pivoted armature carrying a contact arm, normally held central by springs, and the equal action of main and shunt coils in which position an insulated part of the central arm short-circuits the armature windings to stop the motor. If the attraction of either coil increases, the armature tilts and the arm makes contact connecting one or other winding, so that the armature turns and the carbons move in the proper direction to start or maintain an arc. The shunt and field coils may be connected in series between the supply conductors. 6 claims.

20,823. "Improvements in or connected with electric arc lamps." G. T. Davies. Dated October 3rd, 1898. Relates to arc lamps. Two or more carbon rods are clamped together in each carbon-holder, or in only the positive holder of a continuous current lamp, a single carbon being in this case used in the negative holder. An arc forms between the two carbons nearest together at any time, and shifts as these burn away. The invention is stated to give a higher power efficiency than is obtained with large single carbons. It is applicable to ordinary open or enclosed arc lamps, and to lamps such as are described in Specification No. 10,616, A.D. 1898, in which the opposed carbons are at a small angle to each other. 2 claims.

20,829. "Improvements in electric generators and motors." A. Becquentin. Dated October 3rd, 1898. Relates to dynamos and motors, armatures, field magnets, and frames. Two armatures preferably of the ring type are mounted on the same spindle, so as to rotate within the poles, &c., at the opposite ends of a number of straight field magnets, arranged parallel to the axis of rotation. The field cores are secured between two parallel side plates or frames of non-magnetic material, such as brass or aluminium. Between the two armatures is arranged a single commutator, the plates of which are connected with both armature windings. In the case of a four-pole machine, opposite plates of the commutator may be connected together, and a single pair of brushes employed. Motors constructed in this way are especially suitable for electric traction. 3 claims.

20,850. "Improvements in and in relation to the trolley head of electric tramcars." J. W. Towle. Dated October 4th, 1898. Relates to improvements in trolley heads, especially those of the "Globe" type, for electric railways and tramways with overhead conductors. A wheel with a shallow groove runs in the swivelling frame, which has shoulders to replace the ordinary deep wheel flanges. The frame has a short stepped spindle which bears on annular bearing surfaces and may be held in place by a pin. Electrical connection between the head and the conductor is made by a copper nut and cap insulated from the pole by a sleeve and disc. A wedge and screws secure the head on the pole, and a lug is provided to hold the cord. The provisional specification states that ball bearings are applied to the spindle and rollers to the tops of the shoulders. 3 claims.

21,005. "Improved end connections for electric cables." W. T. Henley's Telegraph Works Company, Limited, and R. O. Wright. Dated October 5th, 1898. Relates to end connections for concentric, &c., cables, and particularly to the sealing up of the exposed insulating layers. A sleeve having shoulders is soldered to the metal sheathing, and a cylindrical casing is slipped up to the shoulder covering the bared end of the insulating layer. A metal thimble having shoulders is next slipped on, and soldered to the conductor in such a position as to close the casing. A second insulating casing covering the insulation is placed against one of the shoulders, and is closed by a washer screwing on a metal sleeve soldered to the inner conductor. The casings are filled with insulating composition in a plastic condition through the openings. Connections are made to the metal terminals. 2 claims.

21,044. "Improvements in prepayment electric motors and meters." The British Thomson-Houston Company, Limited. (T. P. Cox.) Dated October 6th, 1898. A coin-freed apparatus closes an electric circuit, on insertion of a coin, until a part of the apparatus has been turned to a definite extent by the shaft of an electric motor or meter in the circuit. The coin is placed in a hollow formed in a disc which is fitted within the upper end of a coin shoot, and can be turned through half a revolution between stops, by a handle, so that the coin passes into the shoot; the disc blocks the shoot so that wires or strings cannot be introduced. When the handle is released, a spring returns it and the disc to their original position, so that another coin may be inserted. The coin passes down the shoot and makes electric connection between a spring and a plate, which is held in position by a spring. The contact spring and plate are connected in circuit with an electro-magnet between the electric supply mains, so that when the coin connects them, the electro-magnet closes a switch in the main circuit of the motor or meter. The motor or meter shaft is geared to a cam-wheel; this in turn first places the contact plate in a certain position, so that the coin moves on, but maintains the connection until the cam-wheel drops the plate to the original position. The coin is then dropped into a receptacle, and the main switch opens, unless a second coin is present in the shoot to maintain the connection between the spring and plate. The apparatus may be used with a motor meter having a commutator and armature connected permanently between the mains. 5 claims.

21,046. "Improvements in electric meters for alternating current circuits." The British Thomson-Houston Company, Limited. (A. G. Davis.) Dated October 6th, 1898. Relates to energy meters for alternating currents. In order to cause the currents in the main and shunt coils to differ in phase 90° on a non-inductive load, adjusted reactance coils are placed in parallel with the main coil and in series with the shunt coil. An induction motor-meter so connected may have a short-circuited drum armature within pairs of main and shunt coils, which are fixed at right angles, one pair outside the other; the armature spindle is geared to a counter, and carries a conducting disc in the fields of permanent brake magnets. 4 claims.

21,047. "Improvements in electric fuses." The British Thomson-Houston Company, Limited. (W. L. Emmet.) Dated October 6th, 1898. In order to prevent destructive arcing, the fuse wire is enclosed in a small chamber having an opening to the air, and the ends are connected to spring arms which fly apart when the fuse melts. The fuse is clamped on the free ends of U-shaped arms which tend to turn down under the action of springs. Between the arm is a block of insulating-material on which are two removable blocks, each block being hollowed so as to form a chamber having a restricted opening. Sliding insulating plates are also arranged between the guard plates. The cut-out may be fitted on a switchboard, contact being obtained with the connecting-bolt by a plate on the casting engaging with the contact. 7 claims.

21,126. "Improvements in and relating to the electrical communication of signals." H. Meehan and D. Muirhead. Dated October 7th, 1898. Relates to electric signaling apparatus applicable for use as an order telegraph on board ship or elsewhere. The spindle of the receiver is provided with a pointer over a dial bearing the orders, and is rotated, with a step-by-step motion, by the electrically-operated pawl and ratchet mechanism. This mechanism is duplicate in opposite directions, the direction of movement of the pointer depending of which of the two operating magnets is energised. The apparatus may be operated by means of pushes at a transmitting station, or by transmitter. In this case the wires of the electro-magnet circuits are connected respectively to contacts on the front and back of the teeth on the wooden or other insulating disc. The contact spring on the transmitting lever normally lies in a diagonal position between adjacent teeth, so that, when the lever is moved to the left, it makes contact with the front contacts, and when the lever is moved to the right it makes contact with the back contacts. In this way, the circuit of one or other of the magnets is completed according to the direction of movement of the lever. The transmitter is also provided with a pointer working over a dial, and may be combined with the reply receiver. A bell or bells are included in the signalling circuits and for "ahead" and "astern" signals, two bells of different tones are preferably employed. 4 claims.

21,150. "Improvements in and connected with electric railways or tramways on a road contact system." E. Hungerbuhler. Dated October 7th, 1898. Relates to electric railways and tramways with road contacts operated partly by magnets on the vehicle and partly mechanically. The contact stud carries an armature which is turned by a magnet on the vehicle, and as it turns it is caused to rise by the roller attached to it rolling over a spring or counterbalanced helical track. The collecting skate then depresses the stud, and completes the circuit between it and the feeder at the contacts. After the skate has passed, the stud rises again and breaks the circuit preparatory to being turned by a second magnet so that it can fall flush with the roadway. The stud is insulated where it works through a stuffing box in the lid of a casing enclosing the switch. The magnets, which may be excited by the main current or otherwise, are placed at right angles to each other, and are mounted so that they can be turned to suit the direction of travel. 8 claims.

21,155. "Improvements in electrically-propelled road vehicles." J. P. Juvenet (E. M. D. de Sibias.) Dated October 7th, 1898. Relates to electrically-propelled cabs and the like, in which the motor and gearing are mounted on a removable fore-carriage. The fore-carriage carries the electro-motor which drives the balance-geared axle of the wheels through suitable toothed and chain reducing gear. The lower part of the fore-carriage carrying the motor is connected to the upper part, which supports the springs, and through them the forward portion of the carriage body, by a pair of parallel discs or rings, preferably with intervening balls or rollers. Steering is effected by toothed gear operated by a vertical shaft and arranged so that the fore-carriage can be caused to turn in one direction or the other as desired. 2 claims.

21,165. "Method of and appliances for exciting alternating current dynamo machines, whether acting as generators or motors." C. D. Abel. (La Societe Anonyme pour la Transmission de la Force par l'Electricite.) Dated October 7th, 1898. Relates to means for exciting alternating current generators or motors for constant potential on the Hutin and Leblanc system, and comprises improvements on the invention described in Specification No. 22,333, A.D. 1896. The exciter is of the nature of a rotary transformer or converter, and runs synchronously with the dynamo it excites, without having any mechanical connection therewith. The details are described with reference to a diagram, and are too complicated for abridgment without reference thereto. 2 claims.

23,888. "Improvements in or relating to coin controlled telephones." W. P. Thompson. (C. H. Kahrs.) Dated November 14th, 1898. Prepayment through a slot allows an hour-glass hanging vertically to be turned till it is in the oblique position shown. One end of a double arm turning with the hour glass is now in contact with a terminal, and the other end is lodged upon a peg borne by a slide having an actuating knob. A coin can only be inserted through the slot when the slide is in the position for determining the closure of the circuit. Thus, in case the user finds he has not been switched on, he may by means of the slide lower the hour-glass into the horizontal position so as to be out of action. When the glass has run down it takes the initial vertical position, the arm slipping from the contact. If mercury is used in the hour glass, the circuit may be made thereby and the external contact be dispensed with. The hour-glass may be vertical when in action if the finger on the slide is made so that it will both raise and lower. 1 claim.

24,052. "Improvements in electric railway systems." J. McLeod Murphy. Dated November 15th, 1898. Relates to the arrangements of circuits for the local sources of energy on electric railway vehicles by which, when the control switch is closed, the high potential armature of the transformer is connected to the feed and return, thus becoming a motor instead of a generator so as to drive the low potential armature. The low potential field coils have an extra circuit switched in when the control arm reaches contact, so that an electromotive force is produced high enough to charge the storage battery. The high resistance coil of the electro-magnetic switch cuts in the low resistance coil when the switch is closed. The high potential field-magnet of the transformer may be provided with the extra circuit, instead of or together with the low potential field magnets. 5 claims.

24,053. "Improvements in crossings for electric railways." J. McLeod Murphy. Dated November 15th, 1898. Relates to crossings for third rail or road contact systems. The surface conducting rails between the crossing rails are made as cross pieces, and non-conducting pieces are placed between the running rails and the ends of the conductors to make the surface of the latter continuous. To insulate the collecting devices from the running rails where the conductors cross, a gap is cut in the rail, or in its head and web, and filled with a short length of rail insulated by a shoe or chair and non-conducting plates under the fish plates, the parts being held together by insulated bolts and nuts. 5 claims.

24,070. "Improvements relating to liquid resistances." E. W. Bowles. Dated November 15th, 1898. Two electrodes are attached to stems coated with insulating material, and are supported adjustably in resistance liquid contained in a vessel by a cord or chain and hand-wheel. Electric connections are made with the upper ends of the stems. 2 claims.

24,104. "Improvements in apparatus connected with the charge and discharge of storage cells in systems of electrical distribution." E. Wilson and J. Mc I. Cater. Dated November 15th, 1898. Relates to systems of distribution with storage cells, and to the means for keeping the potential of the line conductors constant during the charging and discharging. A supplementary generator is employed to raise or lower the potential of the battery circuit. 3 claims.

24,125. "Improvements in and connected with electrical railway signalling apparatus." F. Neumann. Dated November 16th, 1898. Relates to electrical signalling apparatus for protecting, stopping and through trains at stations, and is described as employed on a single line having a loop line at the station, the operation of the signals being effected by means of the apparatus described in Specification No. 25,915, A.D. 1897. To lock the switch bolts at the ends of the loop line, a system of locking levers are actuated by an electro-magnet. The signalling circuits, which are dependent on the condition of the switches, include mercury contacts which are closed respectively by the forked end on the locking lever, and by the lug on the switch bolt engaging the pivoted contact-making flap. The station signals may be arranged to show which line is open, in addition to the usual "danger," and "line clear" indications, two semaphore arms being employed, of which one is put to "line clear" when one line is open, and both are put to "line clear" when the other line is open. The wheels are driven by independent clockwork apparatus of the kind described in Specification No. 25,915, A.D. 1897. The semaphore arms are operated by band gearing from the pulleys which are actuated by the connecting rods from the crank-wheels. The signalling apparatus is controlled from the station by a hand switch, which is moved on to one or other of four groups of contacts according to the direction in which the train is travelling, and the line on which it is to be admitted. The hand switch actuates a contact, which controls the release of the switch bolts, so that the switches cannot be unlocked unless the hand switch is in its neutral position. The hand switch is also locked by a pin, which, when released to permit the movement of the switch, breaks a contact in the signal operating circuit, and so puts the signal to "danger." The operation of the apparatus as a whole, for operating the station signals, without and in conjunction with distant signals, is fully described in the specification, which also describes in detail the various controlling circuits made and broken by the automatic and other accessories. Signal bells are also provided at the station to indicate the correct working of the apparatus, and for giving an alarm in case of a train starting from a station running through the points before the latter are correctly set, &c. Emergency keys are also provided for use in resetting the apparatus to its normal condition, in case its ordinary working has been upset by abnormal causes. 4 claims.

24,655. "Improvements in electric cables." E. T. Greenfield. Dated November 22nd, 1898. Cables for submarine, telephone purposes, are armoured by means of two strips of steel, phosphor, bronze, &c., wound in overlapping open spirals. The two strips are curved in cross-section, the inner one having a central row or projections or a projecting rib. The armouring may be placed over the ordinary lead sheathing, and acts as a protective to boring animals, &c. 4 claims.

24,727. "Improvements in apparatus for measuring and supply of electricity." W. A. Price. Dated November 23rd, 1898. Relates to quantity meters. An electric motor is geared to a counter, and is supplied with driving current from any convenient source through a switch; this is closed or opened by small movements of a magnet which tends to turn in one direction under the action of a stationary conductor carrying the current to be measured, and in the opposite direction under the action of a conductive disc on the motor spindle. The speed of the motor thus varies slightly about a mean speed proportional to the current to be measured. In the particular form the conductor is a straight strip radial to the spindle, and the movable magnet consists of two strips connected by a non-magnetic yoke and magnetised by being situated between the pole-pieces of a large stationary magnet. The parts, contact arms, and a balance weight, are supported near their centre of gravity by a single point. Electric connection with the arm is effected by a point on the yoke touching a stationary spring. Screws are provided for fixing the movable parts for transport. A capacity and resistance in series may be connected across the motor to prevent sparking. A wind shield may be placed between the disc and pole-pieces. In a modification, the pole strips are arranged with free ends on opposite sides of the axis, those on one side embracing the disc only, and those on the other the current conductor, which is coiled into a flat spiral. In another modification, the pole-pieces and yoke are replaced by a movable magnet pivoted on two points, the stationary magnet being dispensed with. Instead of opening the motor circuit, the switch may short-circuit the armature or introduce additional resistance into its circuit, to reduce the speed of the motor. 7 claims.

24,747. "Improvements in or connected with electric sparking devices, more particularly for igniting devices of motors operated by explosive mixtures." E. Houpied and C. V. Girard. Dated November 23rd, 1898. (Convention Date June 13th, 1898.) Relates to sparking apparatus particularly applicable for the ignition of explosive mixtures in motors, &c., the object being to obtain sparks at definite intervals. The main feature of the invention consists in arranging an interrupter, operated mechanically, between the generator and the induction coil. The armature of the generator is mounted on a shaft driven from a moving part of the motor through the pulley. It rotates between the pole-pieces of a magnet and is fitted with a commutator and collecting brushes. The brushes are connected with a condenser and the primary winding of the coil. The interrupter comprises a spring spirally wound on its pivot, a contact, and an operating cam mounted on the spindle. The tension of the spring is regulated by turning the pivot and locking by means of set screws and nut. An ivory plate is mounted on the spring to prevent contact with the spindle. The secondary of the coil is connected to the terminals. 2 claims.